

# PUBLIC WORKS

**Mar.**  
**1961**

**CITY, COUNTY AND STATE**

**Water from a River by  
NATURAL FILTRATION**  
page 91

**Basic Principles of  
PAYEMENT DESIGN**  
*First of 3 Articles*  
page 97

**REFUSE BURNER**  
**Conserves Landfill Space**  
page 117

**Problems in  
EXTENDING UTILITIES**  
**Beyond Urban Limits**  
page 125

**Governmental Regulations  
and the Cost of  
SEWAGE TREATMENT**  
page 126

**SEE PAGE 3**  
**For All Articles**  
**In This Issue**



**John C. Mackie, State Highway Commissioner of Michigan for the past four years, is responsible for more than 100,000 miles of state and local roads and city streets. More data on page 18.**

## Look! Two men can do the work of four...

Actually, with this new Powers-American body and equipment combination, two men can breeze through construction and maintenance jobs that often take a crew of five or more. The Series 555 body, featuring reduced overhang, is common-sense designed to furnish more-than-ample shelves, bins, compartment and cargo space. The corner-mounted "Pole-Master" derrick hydraulically spots and holds at any point from carrying position to ground, anywhere in a horizontal arc that reaches from one side of the body to the other. Optional "Earth-Master" digger automatically attaches to derrick head sheave extension to hydraulically dig anywhere in the derrick horizontal range.

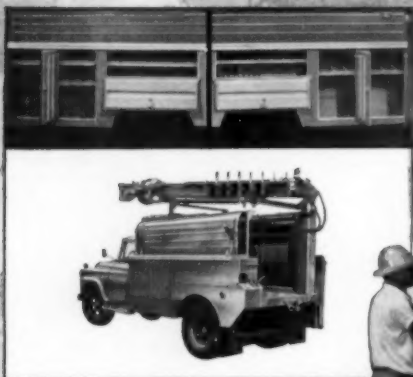
The Series 555 saves where it counts... in manpower and on-the-job time. Equally important, its initial cost goes easy on the new equipment budget. Why not send for details and down-to-earth prices on this work-speeding unit today!

### **McCABE-POWERS BODY COMPANY**

5000 NORTH BROADWAY, ST. LOUIS 15, MISSOURI

625 Cedar St., Berkeley 10, Calif. • 5525 S. E. 28th Ave., Portland 2, Ore.

12121 Los Nietos Road, Santa Fe Springs (L.A.), Calif.



Utilities expect more from

**POWERS** *American*



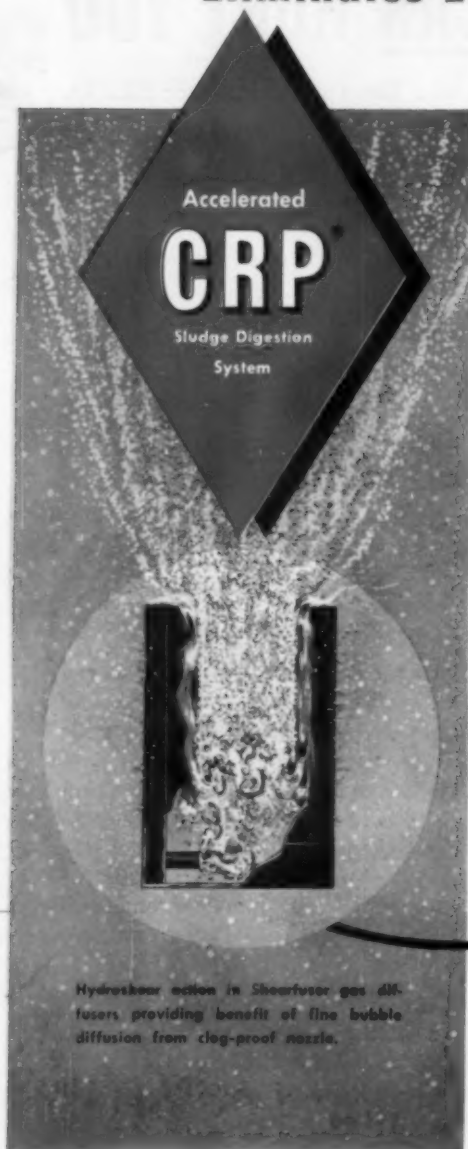
The budget-trimming Series 555 is 112" long, fits 84" CA chassis. Corner-mounted Series PM-30 "Pole-Master" derrick has hydraulic head sheave extension; handles 4-ton loads and 55' poles with ease. Self-stowing "Earth-Master" digs to 10'6" deep, 24" in diameter, in any soil. Underfloor winch line operation is available.



**"Chicago"**  
from

## **CLOG-PROOF SHEARFUSER<sup>†</sup> DIFFUSERS FOR CONTINUOUS DIGESTER MIXING**

**Eliminates Equipment Removal for Servicing**



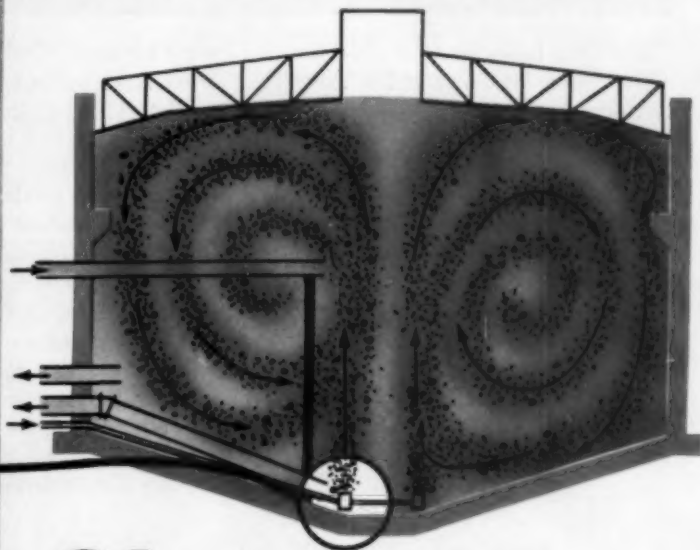
Hydroshear action in Shearfuser gas diffusers providing benefit of fine bubble diffusion from clog-proof nozzle.

### **EXCLUSIVE BENEFITS OF SHEARFUSER DIFFUSERS**

- ① Self-cleaning during gas flow.
- ② Total digester contents mixed by installation on tank bottom.
- ③ No interruption of digester operation.
- ④ Increased mixing rate from fine bubbles induced by Hydroshear action.

### ***CRP Accelerated Sludge Digestion System\****

Reduces tank volume required by high sludge loading rate.  
Produces homogeneous sludge through continuous mixing.



**64** operating and specified installations of the CRP System\* with "Chicago" gas mixing equipment since 1952 prove its unparalleled acceptance . . . servicing cities from 2000 to 250,000 population.

\*System license under U. S. Patent No. 2777815 and foreign patents available.

<sup>†</sup>Pat. Pending

PUBLIC WORKS for March, 1961



Putting Ideas to Work  
FOOD MACHINERY AND CHEMICAL CORPORATION  
HYDRODYNAMICS DIVISION

**CHICAGO PUMP**

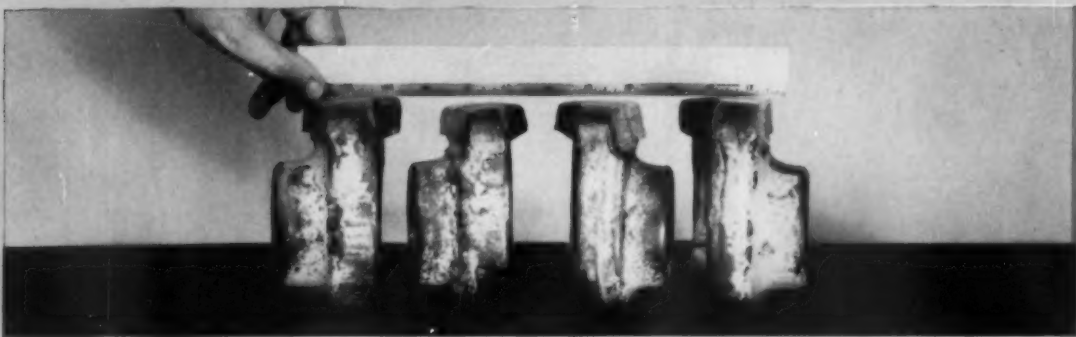
622F DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

## Special Report to Users of Caterpillar Equipment:

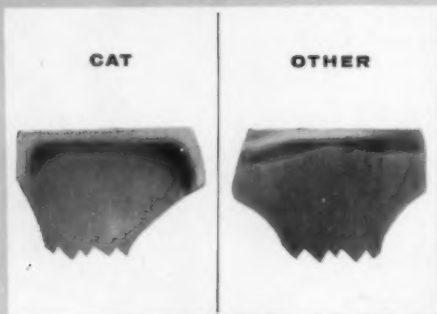


# WHAT YOU DON'T SEE CAN HURT YOU

You can buy a lot of parts that *look* like genuine Caterpillar parts. Some may be cheaper initially. But they are as different as night and day when you get them in service.



Take these links, for example. They all *looked* identical when new. But see what has happened after 2000 hours on the same D8 Tractor! The two links in the center, a popular brand with induction-hardened rails, cost about 9% less than Caterpillar links originally, but showed about 50% more wear.



The extra service you can expect from the Cat links can be seen and compared with other brands. Here are actual photos of etched cross sections of *production* links made by Caterpillar and the other manufacturer. The light areas at top show case depth and pattern of wear-resistant rail material resulting from heat treatment. See the deep, uniform wear case on top *and* sides of the Cat part? It's as hard as a good ball-peen hammer head. But in the other brand, the wear case varies both in depth and hardness . . . that's the reason why after 2000 hours on a D8 the Cat-made links had worn 50% less.

Investigate and you will find superiorities for every undercarriage component built by Caterpillar. This extra quality—though it sometimes costs a little more initially—pays off by delivering *extra* trouble-free working hours. That's why genuine Caterpillar parts cost you less per hour than other brands.

And when it's time to replace or rebuild your tractor undercarriage, see your Caterpillar Dealer. He is an undercarriage specialist with modern facilities to back him up. Get the full story on his many money-saving options and recommendations *tailored to your job conditions*. Truly CUSTOM TRACK SERVICE, designed to save you money . . . and offered only by your Caterpillar Dealer.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U. S. A.

**CATERPILLAR**

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

MARCH, 1961 • Volume 92, Number 3

Natural Filtration .....	91
<i>As an agricultural community, Carmichael, Calif., used a river supply without treatment but new developments required a better supply. An infiltration collection system proved to be the answer.</i>	
JOHN McALLISTER	
Operating Characteristic Curves of Standard Portland Cement Tests .....	94
<i>These characteristic curves offer an effective means of evaluating a cement testing program.</i>	
W. E. HASKELL	
BASIC PRINCIPLES OF PAVEMENT DESIGN:	
Part 1—Pavement Behavior .....	97
<i>This three-part article presents the fundamental concepts for the design of highway and airport pavements. Pavement types and performance and the effects of traffic and climate are considered in this issue.</i>	
E. J. YODER	
Gas Scrubbing for H <sub>2</sub> S Removal and Methane Enrichment .....	112
<i>An unusually high H<sub>2</sub>S content in the sewage sludge gas at Miami, Fla., prompted the special research project reported here.</i>	
A. M. BUSWELL	
Caddis Flies, Fish and Power Plant Condensers .....	115
<i>A sudden invasion of caddis fly larvae in the condenser system of a power plant created a maintenance problem of unprecedented proportions.</i>	
J. W. RUFF	
10-MG Tank Features Construction Economies .....	116
Refuse Burner Supplements Town Landfill .....	117
<i>Limited space for the landfill at Newton, N. J., is being conserved by a refuse burner for combustible wastes.</i>	
DANA WHITMAN, JR.	
Standardization in Engineering Test Procedures .....	118
<i>Increased attention to standard testing procedures on an international scale is the result of engineer shortages.</i>	
J. R. DAVIES	
Fast, Efficient Meter Enforcement .....	120
<i>How substitution of a Truckster for foot patrol has provided better enforcement of parking regulations.</i>	
ROBERT H. VAN DEUSEN	
How Much Do You Spend for Mowing? .....	121
<i>A balance of chemical and mechanical operations promises the most effective and economical turf management program.</i>	
W. L. HOTTENSTEIN	

Backhoe Solves Incinerator Problem .....	123
<i>Machine transfers refuse from storage pits to incinerator charging hoppers, improves safety and efficiency.</i>	
1 MGD Sea Water Conversion Plant .....	124
Administrative Policies for Utility Extensions .....	125
<i>A discussion of the legal problems faced by utility organizations when water or sewer mains are extended beyond urban boundaries.</i>	
JOHN B. POWERS	
Governmental Regulations and the Cost of Sewage Treatment .....	126
<i>A pioneer in the development of high rate trickling filters takes issue with a new regulation of the Central States Sanitary Engineers.</i>	
H. O. HALVORSON	
Hollywood Boulevard Gets Special Luminaires .....	134
Refuse Disposal for a County .....	142
Experience with Pulsating Red Traffic Signals .....	146
<i>A report on a test installation designed to improve driver observance.</i>	
CHARLES ALEXANDER	
400,000 Miles on Diesel Truck Tractor .....	150
Repair Zone Signing and Protection .....	162
<i>Work areas on high speed highways need carefully engineered warnings.</i>	
B. H. BOWMAN	
Community Renewal Planning in New Jersey .....	172
Expanded Pavement Marking Program .....	172
Model Traffic Interchange Educates Motorists .....	174
Equipment Operator Training Boosts Production .....	176
Experience with the Dallas Industrial Waste Ordinance .....	184
<i>First year's operations show plant loads have been reduced and costs equalized.</i>	
W. D. BENTLEY	

### PUBLIC WORKS DIGESTS:

Highways and Airports .....	134
Water Works .....	152
Sewerage and Refuse .....	164
Industrial Wastes .....	178

### EDITORIAL DEPARTMENT

W. A. Hardenbergh, Editor  
Edward B. Rodie, Managing Editor  
Clayton H. Billings, Lloyd G. Byrd,  
Helen E. Quinn, Associate Editors  
Alvin Jacobson, Digest Editor  
Nathaniel Pousette-Dart, Art Consultant

### DEPARTMENTS AND SECTIONS

The Editor's Page .....	7	APWA News Bulletins .....	129
Leader in Public Works ..	18	Municipal Power .....	187
Books in Brief .....	22	Films in Brief .....	190
Reviews of Catalogs .....	34	New Equipment .....	200
Legal Notes .....	60	News of Engineers .....	206
Ed Cleary Says .....	82	Worth Seeing .....	209
Engineering Notes .....	86	Worth Telling .....	210



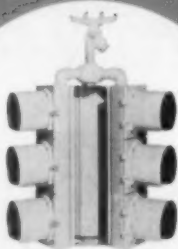
Established 1896  
Public Works T. M. Reg. U.S. Pat. Off.

Published Monthly by Public Works Journal Corporation. Office of Publication at Orange, Conn. Editorial and Advertising offices at 200 So. Broad St., Ridgewood, New Jersey. Subscription rates: U.S.A. and possessions, \$5.00. All other countries, \$7.00. Accepted as controlled circulation publication at Orange, Conn.



PUBLIC WORKS JOURNAL CORP.  
200 So. Broad St., Ridgewood, N. J.

# A Complete Line of Traffic Signals By **ECONOLITE**



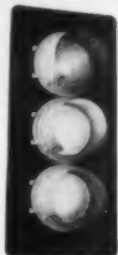
Three way three section 8" Signal  
for Span Wire Mounting  
#3-E31G1G1A-4003A.



12" Signal Adapter, "Red Lens" shown  
installed on 8" Signal. Adapter  
Complete, #TA11GGA.



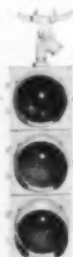
12" Signal Adapter, "Green Arrow"  
shown installed on 8" Signal.  
Adapter Complete, #TA14GGA.



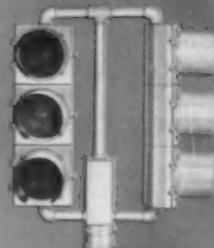
One way three section 12" signal  
with Elevator Plumbizer and Back-  
plate #1-T31G2G2A-8002.

## ADVANTAGES

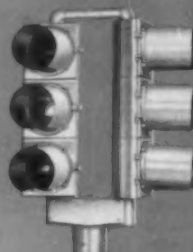
1. Complete assembly flexibility into rigid units.
2. Excellent signal indication and freedom from "sun phantom."
3. Maintenance ease, unsurpassed.
4. Shurlock fittings for positive alignment.
5. Precision die-cast interchangeable parts.



One way three section 8" Signal for  
Span Wire Mounting #1-E31G1G1A-  
4001A.



Two way three section  
8" Signal for Post  
Top Mounting with Ter-  
minal Compartment  
#2-31G3G1A-3002.



Two way three section  
8" Signal for Horizontal  
Post Top Mounting  
with Terminal Compartment  
#2-E31G3G1A-  
8005.



One way three sec-  
tion Combination Sig-  
nal 12" Red 8" Amber  
and Green with Back-  
plate for Adjustable  
Mast Arm Mounting  
#1-C36G1G2A-8011.

**ECONOLITE**  
CORPORATION



Write for further information...

Factory and General Offices  
8900 Bellanca Ave.,  
Los Angeles 45, Calif.





## THE EDITOR'S

# POINT OF VIEW

### Talent Is Required for Maintenance

**T**HE RECENT appointment of Bertram D. Tallamy, former Federal Highway Administrator, as consultant on maintenance to the New York Thruway Authority has promising aspects. First of all, we are pleased to see Mr. Tallamy's great capabilities promptly utilized in a continuing contribution to the highway profession. Secondly, it is especially rewarding to see such talents directed toward highway maintenance. All too often, our highway organizations devote high administrative attention, professional talent and financial backing to the design and construction of highways, while maintenance divisions struggle for funds to operate a stop-gap program with sometimes obsolete equipment and patronage-filled crews. With recognition of the importance of maintenance evidenced by the New York Thruway Authority, other highway departments should feel the need for focusing their attention to this vital function of every sound department. When this happens—and not until then—we can begin to meet our goal of providing better, safer highways.

### A System for Snow Defense

**W**INTER USE of highways is essential if our economy is to continue functioning throughout the year. In attaining a safe use of our highways there are two essentials: What the state, county, city or town can do; what the highway users themselves do.

In general our governmental agencies do a good job of plowing, salting, sanding, etc. There are lapses and there are inadequacies due to poor or insufficient equipment and to attempts at money saving. The greatest handicaps to safe winter driving, however, are the road users.

The winter driving public too often keeps on driving without snow tires or chains—often with smooth tires—irrespective of weather predictions or weather conditions; also, too often, they drive at unsafe rates of speed on slippery or partially cleared highways. Without a better degree of cooperation on the part of highway users, little improvement can be hoped for; in fact, as traffic increases, conditions will worsen.

What is needed is a public relations program, highly educational in nature and intensive as well.

The objective should be to impress on every driver, his or her responsibility in winter driving, and to show precisely what and how each can contribute toward safety in winter driving with quick return of the highway to normal conditions.

This is not a small job; it is one that will require the best in our engineering and public relations efforts—and a lot of patience as well. Now is a good time to start, while the lessons of this winter are still fresh in mind.

### Water Systems Have Been Expanding

**M**OST OF US are acutely aware of the need for expansion and modernization of our water supply systems. The developments of the past few years, including the growth of residential areas and the demands of industry, have created trouble spots, especially in places where adequate advance planning was lacking. Everyone recognizes the need for tremendous increases in the water facilities of the nation. Few appreciate what a job has already been done. For instance, Hartford, Conn., reports that the average annual distribution work over the past ten years is two and a half times the average of the previous 19 years. No doubt this is true for many other well-managed water systems. While not relaxing any effort necessary for the improvement of our water and sewage utilities, we should acknowledge, with appreciation, what has been and is being done.

### Refuse Collection and Fly Control Are Related

**S**TUDIES HAVE been made recently on the volume of fly production from garbage cans. Most home-produced garbage is quickly infected and some studies have shown that where home garbage collections are at one-week intervals, fly production can be quite intense. In fact, in warmer areas of the country, this can be a principal source of flies in residential areas. Since more than 90 percent of the fly production attributed to home garbage occurs after the fourth day, collections on a twice a week basis will greatly reduce emergence. The same result could probably be obtained, in many cases, by a general use of home garbage grinders. This could be a benefit accruing from their use which has not often been considered.

**TESTS PROVE:**

# NEW JOINTING MATERIAL LASTS LONGER THAN SUBSTITUTE PIPE

Lifetime Vitrifed Clay Pipe—which is chemically inert and can't be damaged by gases and acids normally found in sewer lines—has been the standard of excellence for centuries.

But how about the new resilient jointing materials now being used on Clay Pipe? How do they stand up under acid attack?

Samples of standard jointing material have been suspended in sewer lines in cities all over the country to see how they react to normal exposure. But we wanted to find out quickly if they stand up to sulphuric acid—the number one killer of sanitary sewer lines built of substitute pipe.

In one test, samples of cement-asbestos, concrete and clay pipe and five jointing materials were weighed dry, then exposed to a five-percent sulphuric acid solution for 100 days. They were then removed from the acid, dried, and weighed again to observe weight loss and disintegration.

The results were amazing!

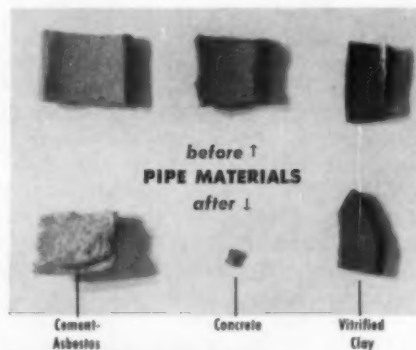
The sample of concrete pipe was completely disintegrated. The sample of cement-asbestos pipe was badly laminated and almost disintegrated.

But there was no evidence of any deterioration of either the jointing materials or, naturally, the Vitrifed Clay Pipe.

Get all the facts\* before you specify any kind of pipe for your community's sewer line. There's no substitute for lifetime Vitrifed Clay Pipe with the new compression joints.

\*Further explanation of this experiment is available on request.

Pipe and  
jointing  
materials  
after  
100 days  
exposure  
in 5%  
Sulphuric Acid  
Solution



**6 NEW JOINTING MATERIALS**



Untouched photographs made at the NCPMI Research Laboratory

NATIONAL CLAY PIPE MANUFACTURERS, INC.  
1028 Connecticut Ave., Washington, D. C.

Please send me full details on the new factory-made  
compression joints on Clay Pipe.

(name) \_\_\_\_\_  
(company) \_\_\_\_\_  
(street address) \_\_\_\_\_  
(city and state) \_\_\_\_\_

B-2C1 PW

COMPRESSION SEALED, VITRIFIED

# CLAY PIPE

THE STANDARD in SANITARY SEWERS

**NATIONAL CLAY PIPE MANUFACTURERS, INC.**

1028 Connecticut Avenue

Washington 6, D. C.

**MORE HAUL!**

**NO STALL!**

**MORE THRIFT!**

**NO SHIFT!**

**MORE GUTS!**

**NO BUTS!** (...IFS  
OR  
ANDS!)

First on the job, last off — Moline's MoTrac puts out more work per dollar invested than any other crawler. Here are some reasons. The MoTrac's

Torque Converter drive with toe-operated Hydro-Shuttle lets you change speed or direction *instantly*. From full ahead crowding to full reverse without shifting. And your

hands are free at all times to steer and load.

Result? Faster cycles, more yardage per hour.

No stalling under heaviest loads either; no wasted time. Reason? The famous Moline engine, built for high torque at low rpm. Plus the heavy cast and solidly bolted power train—an unshakeable column of strength

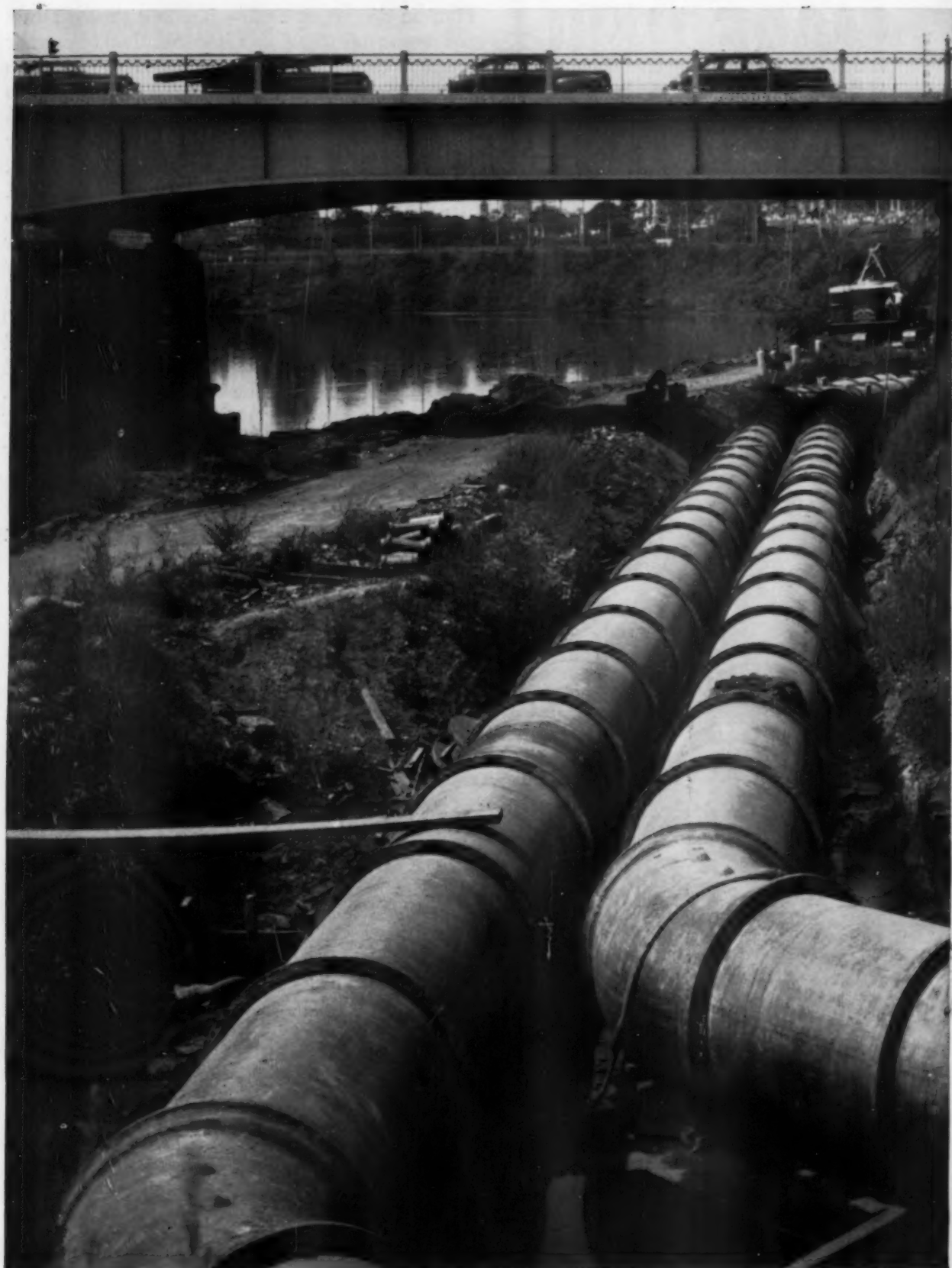
from end to end. And here are more features: 1000 hour service rollers, simplified controls, 1¼ yard bucket. For maneuverability, versatility, and solid build you can't beat the MoTrac at *any* price. You'll tackle anything and everything with your MoTrac. Test drive it at your Moline dealers today.



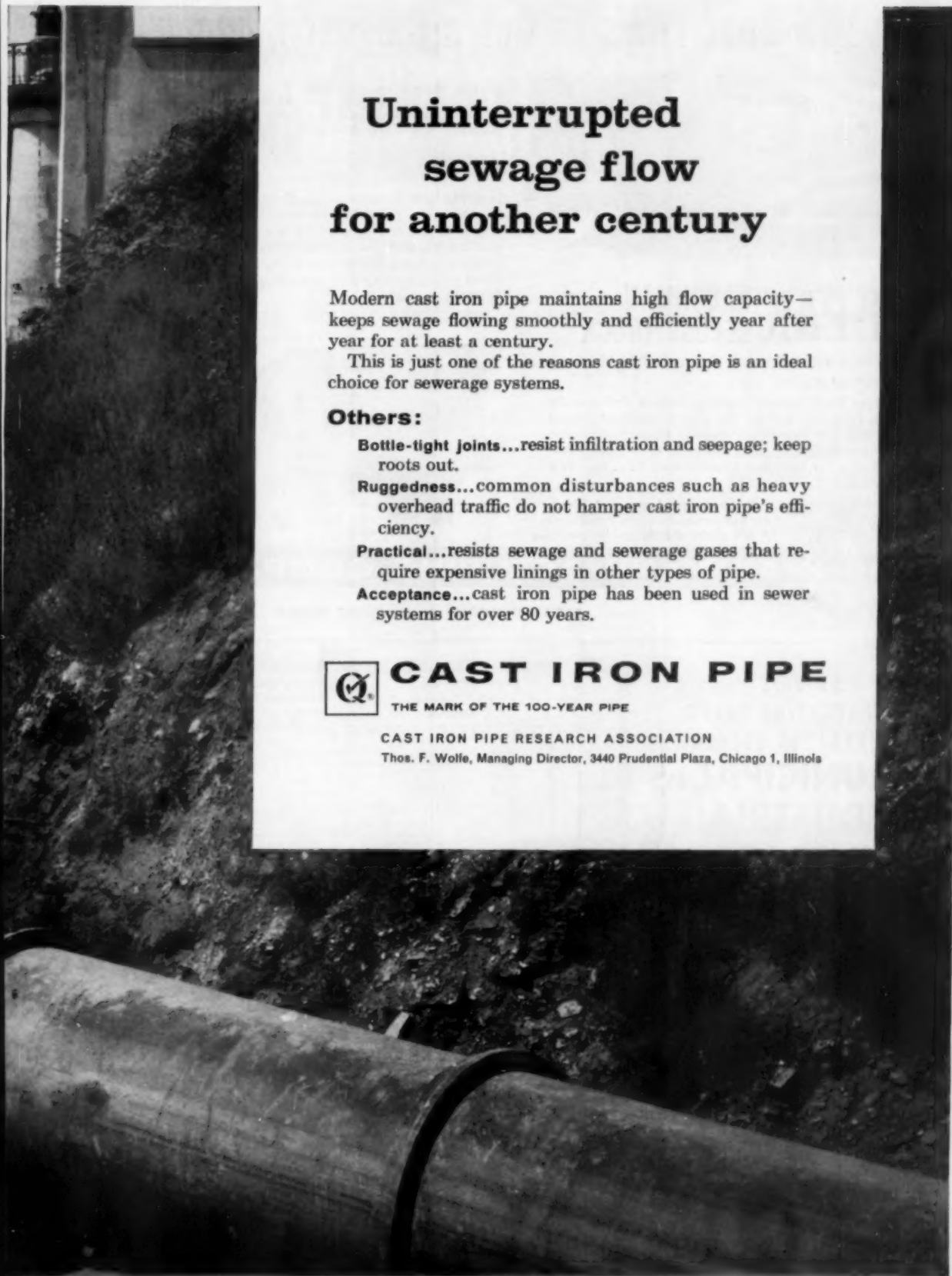
**MoTRAC** <sup>®</sup> BY **MINNEAPOLIS Moline**

PUBLIC WORKS for March, 1961









## Uninterrupted sewage flow for another century

Modern cast iron pipe maintains high flow capacity—keeps sewage flowing smoothly and efficiently year after year for at least a century.

This is just one of the reasons cast iron pipe is an ideal choice for sewerage systems.

### Others:

**Bottle-tight joints**...resist infiltration and seepage; keep roots out.

**Ruggedness**...common disturbances such as heavy overhead traffic do not hamper cast iron pipe's efficiency.

**Practical**...resists sewage and sewerage gases that require expensive linings in other types of pipe.

**Acceptance**...cast iron pipe has been used in sewer systems for over 80 years.



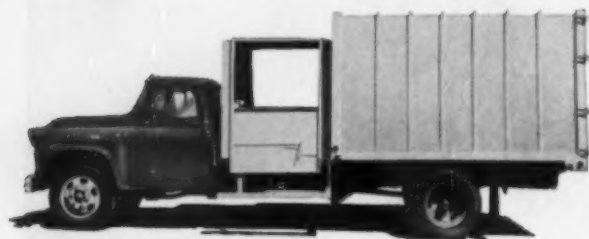
## CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

# Two Low-Cost Ways to Get a Cleaner Community



## RAM-PAK BAUGHMAN REFUSE TRUCK

The self-packing, self-unloading refuse body with many exclusive features:

Ram-Pak Refuse Truck has self-packing feature that permits more rubbish collecting before dumping is necessary. Load from both sides, has large crew ramps. Water tight body. Dumps automatically with powerful twin ram hoists. Two body sizes. Write for Leaf-Vac Bulletin A-457 . . . Ram-Pak Bulletin A-433-A.



Better service through better engineering.  
Parts and service from 200 distributors  
A few choice distributorships available

**BAUGHMAN MANUFACTURING COMPANY, INC.**

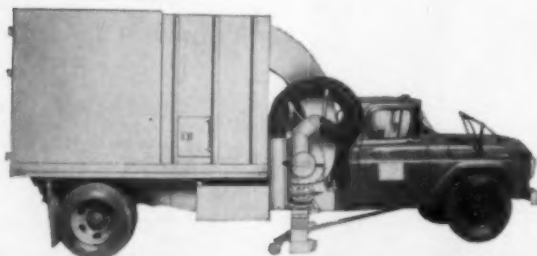
308 SHIPMAN ROAD • JERSEYVILLE, ILLINOIS

6089

## LEAF-VAC BAUGHMAN LEAF SWEEPER

The modern vacuum-action method for cleaning leaves from streets and gutters.

Leaf-Vac Leaf Sweeper does efficient leaf and twig collecting through powerful vacuum suction, has auxiliary engine to power blower. A 12-foot hose attachment cleans catchbasins and the curb-to-sidewalk area. Collects full 5-foot swath without raising dust; vapor spray keeps dust down while loading and unloading. Dumps automatically. Three body sizes.



## DETROIT RECIPROCATING GRATE INCINERATOR STOKER FOR MUNICIPAL AND INDUSTRIAL INCINERATORS

- Alternate lateral rows of reciprocating grates convey the refuse mass through the firing chamber, tumbling and tearing it, to expose its maximum surface to flame, and without manual poking.

- High resistance air metering grates prevent bare spots and blow holes.

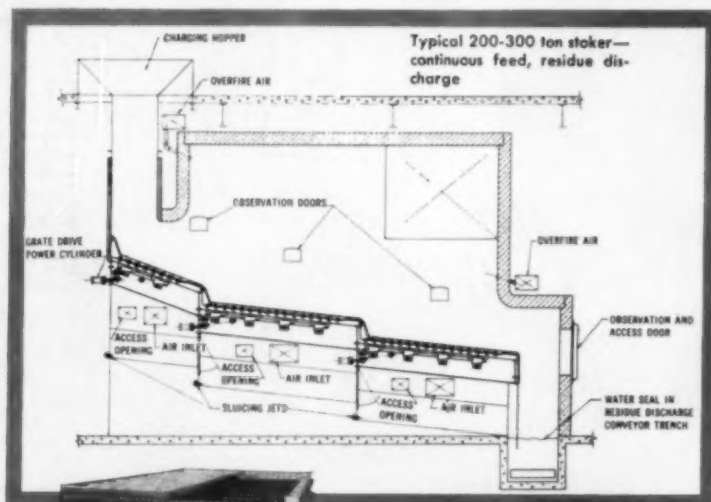
- Hydraulic drive, automatically controlled for selected frequency and length of grate-reciprocating strokes.

- Factory-assembled for shipment in modular units (single or multiple) for any size incinerator, assure a minimum of field erection labor.

- Full details and specifications in Bulletin 701. ASK for IT.

Also Available—

**Detroit Rocker Grate Incinerator Stoker**



Two-unit stoker with drives and controls, being shop-assembled

**DETROIT  
SINCE 1898  
STOKERS**

## DETROIT STOKER COMPANY

DIVISION OF UNITED INDUSTRIAL CORPORATION

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

# **COILFILTER DEWATERS BEATRICE, NEB., FRESH SOLIDS AT 9.2 LBS. PER SQ. FT. / HOUR MONTHLY AVERAGE RATE**

## **COILFILTER OPERATING DATA**

City of Beatrice, Nebraska

Month July

Equiv. Pop. 12848  
(Sus. Solids)

100  
sh Solids - Primary &  
Trickling Filter

sh Solids - Primary & Cking Filter					(Sub. Solids)			
GE	Chemicals vs Dry Wt. Solids		FILTER CAKE		pH sludge before chem	pH sludge after chem	pH sludge from **	
	Pounds Dry Solids Filtered	Pounds Used	Percent Used	% Moisture				Yield lbs./sq. ft./hour
	Lime	FeCl <sub>3</sub>	CaO	FeCl <sub>3</sub>				
7197.0	850	89	7.1	1.2	76	8.4	6.4	11.8
10773.2	735	120	6.8	1.1	72	10.7	6.8	12.0
7619.5	420	64	5.5	0.8	76	10.8	6.8	11.8
7824.5	490	67	6.2	0.8	76	10.4	6.4	12.0
5724.9	550	58	6.7	1.1	74	8.2	6.2	11.8
3973.3	400	42	7.0	1.5	76	7.9	7.0	11.8
6620.7	700	64	7.4	0.9	75	9.4	6.8	11.8
5764.2	600	59	7.2	1.2	74	8.2	6.6	11.8
5615.3	500	47	6.1	0.9	72	11.2	6.8	12.0
6714.2	650	64	6.7	0.9	76	9.5	6.8	12.0
5874.4	650	61	7.7	1.3	79	8.3	6.6	11.8
5939.2	600	67	7.0	1.1	76	8.4	6.8	11.6
4.2	79658.4	7145	802					
61	6638.2	595.4	66.08	6.71	1.06			
ays	39.82 (Tons)	3.57 (Tons)						

MONTH'S  
AVERAGE

\*\*Note: PC  
HT for  
D for

\*\*Note: PC  
HT for  
D for

**MONTH'S  
AVERAGE**

LTER DEWATERING COST				
Unit	Cost	Cost per Month	Cost/ton dry wt.	Cost/ca- pita/yr.
52	12.55	100.25	2.86	.093
145	1.25	85.74	3.32	.080
147		185.99	6.18	.173
3-460				

\*For Filtration Operation Only

Signed: Wayne Matting

Title: Water Supt.

Date: 8-8--60

Keep in Duplicate  
Mail one copy to:  
Kornline-Sanderson  
Engineering Corporation  
Peapack, N.J.

**KOMLINE-SANDERSON  
ENGINEERING CORPORATION**

**PEAPACK, NEW JERSEY**

CANADIAN OFFICES AND PLANT  
BRAMPTON, ONTARIO, CANADA

**KOMLINE-SANDERSON'S  
NEW ADMINISTRATIVE  
CENTER AT PEAPACK, N. J.**



PUBLIC WORKS for March, 1961

# Flexible presents **3**

Before you invest important money in sewer rodding equipment, investigate these three fine new machines. As in the past, Flexible has taken proven and tested design principles, and added important new features to give you the best equipment for any job.

As a manufacturer of all types of rodding machines, Flexible is in a position to offer you **any** type without partiality. The work to be performed is the determining factor for most satisfactory machine selection.

Now! A simplified continuous rodder free from slippage when the going gets heavy, with the exclusive advantage of the proven Safety Overload Clutch. **NO FRICTION ROLLERS TO SCORE OR BURN.** Traveling cams positively push or pull the rod, gripping tighter when the load increases. Unequaled design permits cams to rotate with the rod, in either direction. For 1/4, 5/16, 11/32 or 3/8-in. continuous rod. Holds up to 2000 ft.



*new!*

**1961**

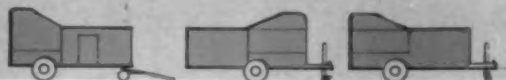
**SEWERODER**

PATENT NO. 2,544,256

**WRITE TODAY  
FOR FREE  
CATALOG!**

Built with the ruggedness and reliability of the full-size SeweRoder, this new Compact is 15 inches shorter and priced to fit economy budgets. Uses 3/8-in. rods driven by hardened steel dogs on positive dual chain drive. Two-wheel tow with caster type wheel at front; 7 hp engine; reel capacity 750 ft. of rod.

**FLEXIBLE INC.**



415 S. ZANGS BLVD., DALLAS, TEXAS

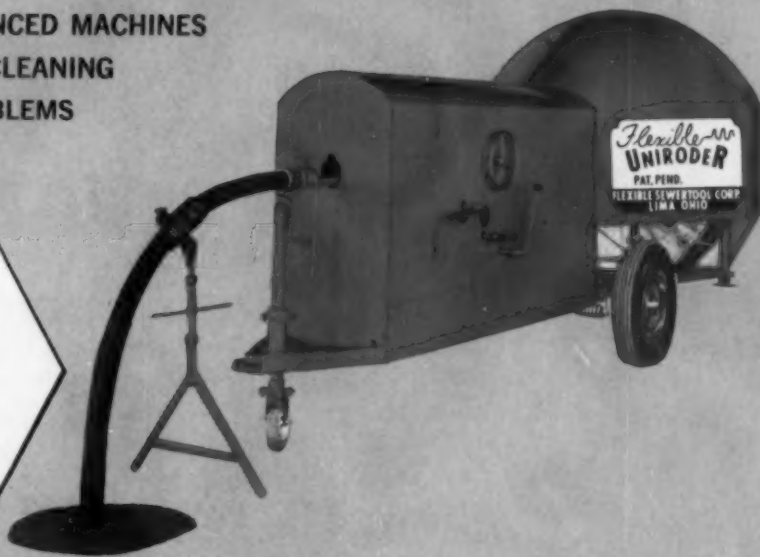


# new rodding machines!

1961's MOST ADVANCED MACHINES  
FOR YOUR SEWER CLEANING  
AND RODDING PROBLEMS

*new!*  
**CAM DRIVE  
UniRODER**

PAT. PENDING



Now features 48-in. rods providing extra operational economies. Twice as many drive dogs on new longer dual chain drive for faster, smoother, positive power. These and other redesign features make it the greatest performer on the market today...all at no increase in price over previous years. Engine 9.2 hp; reel capacity 900 ft. of rod.

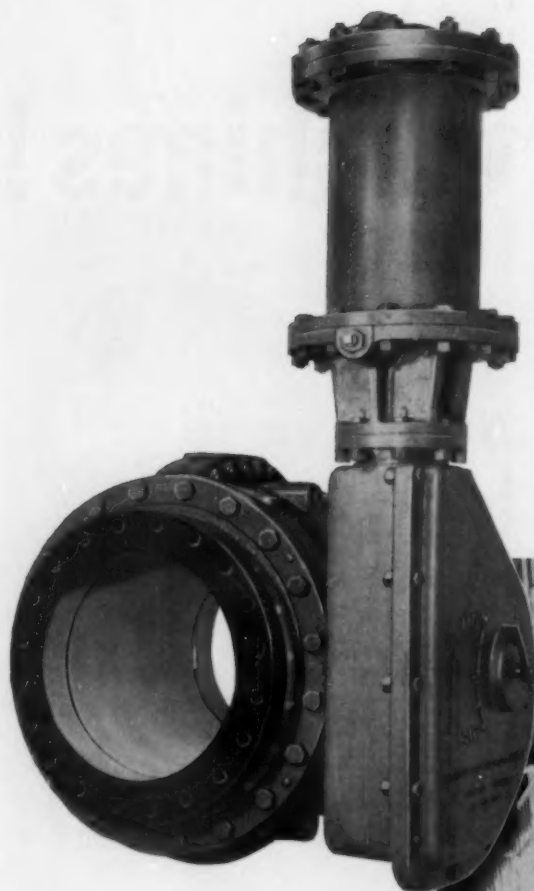
*new!*  
**COMPACT  
SEWERODER**

PATENT NO. 2,544,256



FACTORIES AT LIMA, OHIO AND LOS ANGELES, CALIFORNIA

PUBLIC WORKS for March, 1961



# Willamette LIST 26 BALL VALVES



*In Kansas City, Missouri, every drop of treated water passes through Willamette Ball Valves in pump check service. Shown above are 5 of 15 Willamette List 26 Ball Valves in automatic pump stop and check service at Secondary Pumping Station. Elsewhere in Kansas City, there are over 120 Willamette Ball Valves in service, including 116 in the distribution grid, in sizes 10" to 42".*

Preferred for automatic pump stop and check service, pressure regulating, and strategically located shut-off applications. At present, Willamette Ball Valves are in service in over one hundred cities throughout the country.

**WILLAMETTE**  
**iron and steel company**

2800 N.W. FRONT AVENUE • PORTLAND 10, OREGON

VALVE DIVISION





## You'll stay ahead when the "Chief" leads the way!

Extra surface rolled every hour—that's one of the proved advantages when you operate the Galion "Chief" pictured above. Size for size it gets more done—faster—than other rollers of its type.

Its rugged design increases your rolling efficiency tremendously. Power-to-spare engine, hydraulic steering, fingertip control and Roll-O-Matic Drive result in better compaction with a smoother surface.

Take Roll-O-Matic Drive, for example, which applies power automatically. This one Galion feature alone promises at least 10% more surface rolled in any given time, under any terrain conditions, up grades or down.

For complete information contact your Galion distributor or write for Bulletin 410-A.



**RENT A ROLLER**  
Ask your Galion distributor  
about our cost-cutting  
Rent-A-Roller Plan.

THE GALION IRON WORKS & MFG. COMPANY, GALION, OHIO, U.S.A.

General and Export Offices: Galion, Ohio, U.S.A.—Cable Address, GALIONIRON, Galion, Ohio

# "Call FOSTER... get Line Pipe PLUS"

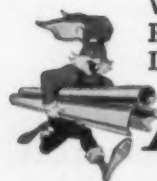


When you need large diameter pipe, especially 12½" thru 48", L. B. Foster Co. can supply all you need from any one of its seven nationwide warehouses. And where's the "plus"? It's the "Faster From Foster" service that speeds your order.

As one of the country's major pipe specialists, Foster offers a one stop source to water works engineers and superintendents for municipal and industrial line pipe. This includes bare pipe and "controlled-quality" coating and wrapping—or lining—up to 78" diameters, and to all standard specifications.

Also, check Foster for savings on Structural Grade pipe—ideal for non-pressure use, and for water well casing and pump columns.

Write **L. B. FOSTER CO.** for Stock List PW-3, Pittsburgh 30, New York 7, Chicago 4, Houston 2, Los Angeles 5, Atlanta 8, Cleveland 35.



***Faster From Foster***  
Pipe • Valves • Fittings • Piling • Rail



**John C. Mackie** was elected State Highway Commissioner of Michigan on April 1, 1957, and assumed office on July of that year at the age of 37 years, the youngest man ever to hold the office. By statute, Commissioner Mackie is vested with full charge and control over all roads built and maintained on the 9,400-mile state trunkline system in Michigan. He is also the sole reporting agent to the State Legislature and Governor for the accounting of expenditure of funds by the county road commissions on the 85,000 miles of roads and by cities and incorporated villages on the 14,000 miles of roads and streets over which they have direct jurisdiction.

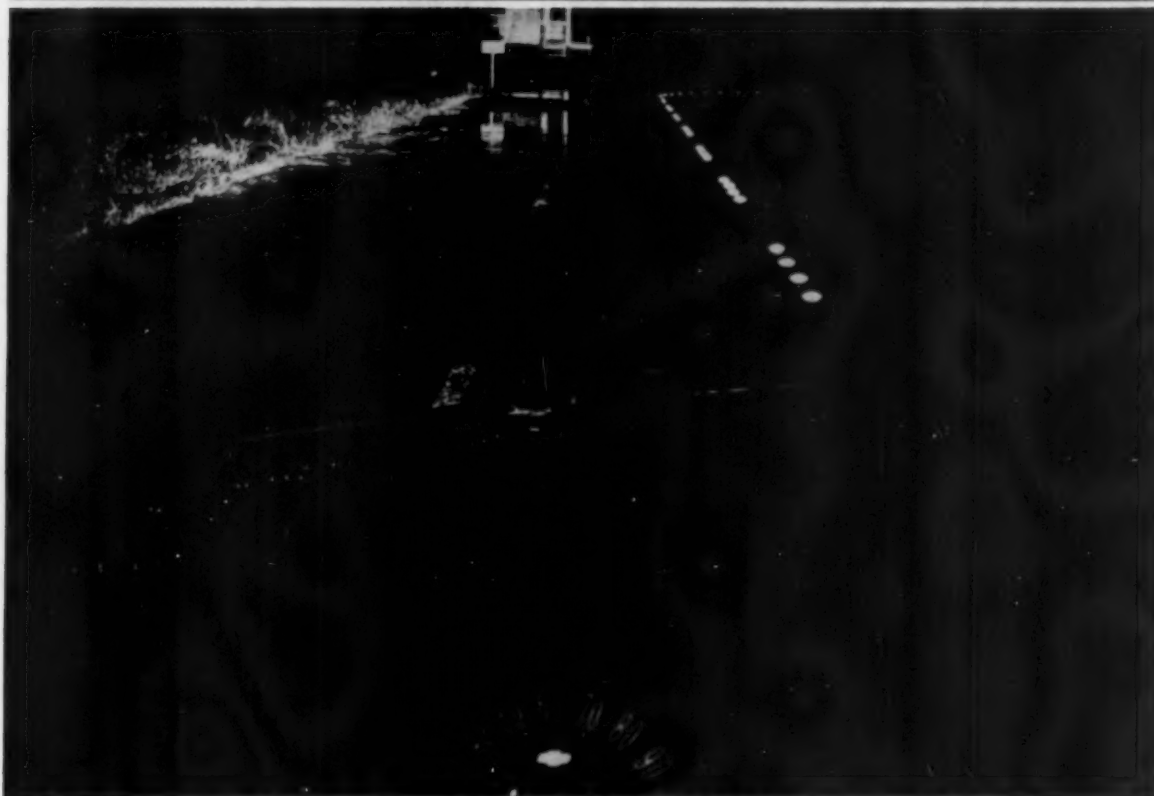
Also by statute, he is a member of the State Administrative Board, State Board of Aeronautics, Water Resources Commission, Highway Reciprocity Board, Mackinac Bridge Authority, State Personnel Council, State Office Building Commission, Inter-Agency Council for Recreation, State Safety Commission and Michigan Turnpike Authority.

He is a graduate of Michigan State University, from which he received a BS degree in Civil Engineering. Soon after his graduation he enlisted in the Air Force and after further training was commissioned a second lieutenant and assigned as base weather officer for an Air Force fighter wing at Norfolk, Va. Later, after completing a Flight Control course, he was sent to Tarawa Island as operations officer for the ATC; and subsequently to Kwajalein Island and Hickam Field, Hawaii. Following his separation from the Air Force in 1946 as a first lieutenant, he joined a Detroit consulting engineering firm and later founded his own surveying and engineering firm.

He is a member of numerous engineering and technical groups and a member of the executive committee of the AASHO. In addition to being a handball enthusiast, he is a farmer, operating an 80-acre farm near Lansing. He and Mrs. Mackie, the former Kathleen Flood, have three daughters.



## Announcing—A MAJOR ADVANCE IN HIGHWAY MARKING SYSTEMS



Unretouched driver's-eye view comparing newly painted glass-beaded traffic stripe with American-Marietta's Lite-Lane Traffic Marking System under wet road conditions—high beam.

# WHEN WET TRAFFIC STRIPES VANISH NEW *Lite-lane* STAYS BRILLIANT!

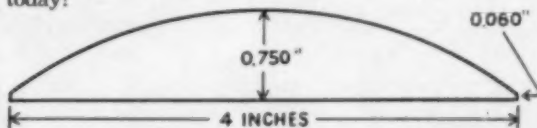
**SUPERIOR NIGHTTIME VISIBILITY**—when heavily glass-beaded paint stripes disappear on wet surfaces, American-Marietta's amazing new Lite-Lane markers remain brightly visible. Even when rain and fog make conventional systems useless, Lite-Lane provides exceptional reflectance when needed most.

**EFFECTIVE TRAFFIC CHANNELING**—day or night Lite-Lane clearly stands out. Its low convex profile safely and audibly warns careless or drowsy drivers that they are straying from their lane without offering impact hazard.

**EXCEPTIONAL DURABILITY**—Lite-Lane markers will survive extreme traffic conditions to remain intact and highly reflective for at least 7 to 10 years. Because the durable plastic base material contains a uniform dispersion of glass beads, wearing action of vehicle tires constantly

exposes brilliant new reflective surfaces—**Lite-Lane markers stay bright throughout their entire life.**

**COMPLETE SYSTEM**—Lite-Lane Traffic Guide Markers are part of a complete system. It includes tough and durable epoxy-type adhesive for marker-to-pavement bonding, semi-automatic application equipment, and method of installation which insures top performance. This system developed by American-Marietta engineering and research provides minimum in-place costs without maintenance for the long life of the markers. Get the facts today!



### Send for Complete Details

Write Dept. A & P for detailed booklet outlining facts you want to know about the LITE-LANE TRAFFIC GUIDE SYSTEM.



### AMERICAN-MARIETTA COMPANY

Adhesive, Resin and Chemical Division  
3400 13th Avenue, S. W.  
Seattle 4, Washington



# **TRAXCAVATORS...fast...safe...**

## **ALWAYS READY TO GO**



# easy to operate WHEN YOU NEED 'EM

◀ The town of Canaan, New York, and the township use this 955 Traxcavator to widen gravel roads, load gravel and plow snow. The operator says this 955 is three times better than previous machine. Power shift transmission speeds operation. Lifetime lubricated rollers and dry-type engine air cleaner cut maintenance time.

## 3 TRACK-TYPE TRAXCAVATORS

**933—1½ YD. STD. BUCKET—52 HP (flywheel)**  
Cat Diesel Engine—direct drive transmission with Cat exclusive oil clutch.

**955—1¾ YD. STD. BUCKET—100 HP (flywheel)**  
Cat Diesel Engine, turbocharged for efficiency—single lever control power shift transmission.

**977—2½ YD. STD. BUCKET—150 HP (flywheel)**  
Cat Diesel Engine, turbocharged for efficiency—single lever control power shift transmission.

◀ Franklin Township Road Dept., Murrysville, Pa., uses this 944 Traxcavator summer and fall for widening, repairing and building roads . . . plowing, cindering and keeping roads open in winter. To get equipment that's ready to go when they need it, Franklin Township purchases on a best buy basis, not necessarily on low bid.

## 3 WHEEL-TYPE TRAXCAVATORS

**922—1¼ YD. STD. BUCKET—80 HP (flywheel)**  
Cat Diesel Engine, turbocharged for efficiency (gasoline engine also available)—Cat power shift transmission—four forward speeds—four reverse speeds.

**944—2 YD. STD. BUCKET—105 HP (flywheel)**  
Cat Diesel Engine, turbocharged for efficiency (gasoline engine also available)—Cat power shift transmission—four forward speeds—four reverse speeds.

**966—2¾ YD. STD. BUCKET—140 HP (flywheel)**  
Cat Diesel Engine, turbocharged for efficiency—Cat power shift transmission—four forward speeds—four reverse speeds.

The unpleasant truth is . . . you can use up more of your budget maintaining an undependable machine than you spend on the loader that's always ready to do your jobs.

Your own records will show Traxcavators' unmatched dependability. Cities and counties, contractors and industrial companies have recorded operating costs and machine service hours that unquestionably prove that you can get more work out of Traxcavators than other loaders. Traxcavators are built better. And the Caterpillar Dealer keeps a full inventory of parts so that when your loader does need a quick repair you get fast service . . . constant availability.

And you get more than availability . . . you get the easiest operating, *fastest* loaders on the market. With power shift transmissions, automatic controls, Traxcavators make good operators even better in a hurry.

And when you need high production—need to load or feed 4000-5000 tons of material a day—look to the big 977 track-type or 966 wheel Traxcavators.

All your work, the tough stuff, the easy jobs . . . they're all handled faster and easier with a Traxcavator. Call your Caterpillar Dealer . . . do business with the man whose business is built on dependability.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

## THESE FEATURES MAKE GOOD OPERATORS EVEN BETTER

**SAFETY** Lift arms and cylinders are all forward of the operator, give him complete freedom of movement; good visibility and automatic bucket positioners help him get top performance from the machine. Heavy frame and the design geometry give excellent stability.

**LIVE-ACTION HYDRAULIC SYSTEM** Plenty of power is always available to the big hydraulic cylinders to give fast and powerful bucket action. Control valves are enclosed in reservoir and system is full-flow filtered for protection from dirt.

**POWER SHIFT TRANSMISSIONS** Fast, effortless power shifting in first and second speeds, forward-reverse gives 25-second cycles to make each operation faster and easier. (On all but the 933 track-type loader.) Wheel loaders have 4-wheel drive for work, 2-wheel drive for travel.

**SIDE DUMP BUCKET** Interchangeable with the standard bucket, exclusive Cat side dump bucket eliminates turning, requires less loading space . . . dumps to left or forward. Lift forks, special material buckets and other attachments are available to make your Traxcavator more versatile the year 'round.

# CATERPILLAR

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

**TRAXCAVATORS  
ARE MAKING OTHER  
LOADERS OBSOLETE**



## ALL NEW! FULLY TRANSISTORIZED

*Detectron*

### PIPE DETECTOR



In addition to the famous model "505" Detectron now offers its completely new model "808" with the first circuitry developed specifically for use with transistors. It is NOT merely an adaptation of earlier tube circuits.

Efficient under every known operating condition, effective in varying temperatures, thoroughly proven and trustworthy. Superior performance and reliability guaranteed.

#### EXCLUSIVE FEATURES

- ▲ Detects Deeper by all comparisons
- ▲ Automatic Switching for direct connection
- ▲ High Energy-Transfer-Ratio
- ▲ Printed Circuits, properly shielded
- ▲ Separate Oscillator System
- ▲ Highly Perfected Loop Antennas
- ▲ Economical Standard Long-Life Batteries
- ▲ Built-In Battery Testers
- ▲ Snap-Lok Connecting Handle
- ▲ Aluminum Cases for maximum protection



Written Lifetime Guarantee  
on CMC parts  
and workmanship

For specifications and prices,  
write for File No. Dept. 147

**COMPUTER-  
MEASUREMENTS CO.**

Utilities Instruments Div.

12970 BRADLEY, SYLMAR, CALIF.



#### APWA YEARBOOK FOR 1960

This yearbook of the American Public Works Association is a fine job, presenting much useful material. It contains the directory of officials; the constitution and chapter regulations; and the proceedings of the 1960 Public Works Congress. In addition there are papers, complete or somewhat condensed, on many public works problems, by leaders in the field. Among the subjects are: refuse collection; street cleaning; snow and ice removal; traffic and parking; safety; surveying and mapping; sewage and waste disposal; composting; incineration; street lighting; and finance and accounting. There is also a list of all members, with addresses and titles. 458 pages; offset; \$5. Order from American Public Works Association, 1313 East 60th St., Chicago 37, Ill.

#### FORECASTING FOR HIGHWAYS

Two papers before the Highway Research Board cover failures in past traffic forecasting; suggest ways of making future forecasts more realistic; evaluate procedures in current use; and discuss some key factors which show promise of improving techniques. Bulletin 257; 38 pages, \$1 from the Board, 2101 Constitution Ave., N.W., Washington, D. C.

#### ENGINEER LICENSING REVIEW PROBLEMS

Here are 1301 review problems for engineer-in-training and engineering registration examinations, with answers and typical solutions. All of the problems have been selected from actual registration examinations given in one or more of the 35 states from which tests were available, but questions are not identified by state of origin. In addition, nine complete actual examinations are given in Part III, one for each of the basic branches of engineering—chemical, civil, mechanical, etc.

Part I covers the 11 fundamental subjects—mathematics; chemistry; statics; dynamics; physics; strength

of materials; thermodynamics; fluid mechanics; electricity; engineering economy; ethics in practice; contracts; and specifications. This section contains about 150 pages. Part II is the applied engineering section and covers the various branches of engineering in its about 140 pages.

The authors are R. C. Brinker, J. J. Bourquin, P. C. Hassler, J. A. Whitacre, Jr., and P. W. Young, all of Texas Western College. International Textbook Co., Scranton 15, Pa. \$7.50.

#### BUILD FOR TOMORROW

This is an intensely interesting book about Harry S. Price, Sr., construction man, builder of dams and founder of Price Brothers Co., Dayton, O. This was a man who shot a 78 at golf when he was 78 years old and this accomplishment is, in a nutshell, how he did things all his life. To engineers who are not golfers, the fertility of mind and the ready resources of new ideas whereby he was able to overcome so many construction difficulties make the book interesting and also valuable. To older men, who can recall the days of Mr. Price's prime, the reading will bring many memories; but we would like, even more, to have young engineers read it. If they can catch the spirit in this little book (160 pages; illustrated), it will help them to meet the coming problems and to solve many of them. A limited number of copies are available. Write to Price Brothers Co., 1932 E. Monument Ave., Dayton 1, Ohio, for a copy.

#### TAXES FOR THE SCHOOLS

This is the second and final volume reporting a research project on "Financing Public Schools." It is reviewed here because our present high costs for education can affect materially the funds available for other pressing needs, as public works. Since World War II collections have increased from income taxes 62 percent, from sales taxes 210 percent and from property taxes 225 percent. National income meanwhile has increased 118 percent. In the past 20 years, school enrollments increased 43 percent and school funds grew by 185 percent. By 1970, enrollment is expected to climb 28 to 30 percent, and school outlays to double. More effective use of available facilities would reduce the need. By Roger A. Freeman; 441 pages; \$5. The Institute for Social Science Research, Continental Bldg., Washington 5, D. C.





## DIG TRENCH AND BELLHOLES IN SINGLE PASS

**The Cleveland JS-30 Trencher  
digs bellholes at pipe joints,  
digs flush to obstructions,  
slopes as it digs.**

Note the ample-width bellhole in the foreground above. The JS-30's exclusive power-shifted digging wheel shifts  $2\frac{1}{2}$  feet to each side of center to dig bellholes like this and to keep trench in line even when crawlers are being steered around side obstructions.

The JS-30's wheel power-tilts, too—saves blocking and cribbing when either crawler track is higher than the other on curbs, side slopes, etc.

Note, too, how the JS-30's power-shifted V conveyor with operator-controlled speeds up to 1,000' per



minute—another Cleveland exclusive—easily handled the big spoil volume from the wide-sloped trench. The JS-30 sloped the trench to 6' top width as it dug.



*The JS-30 is a trencher  
of amazing utility. Write  
today for all the facts.*



# CLEVELAND TRENCHER

THE CLEVELAND TRENCHER CO., 20100 ST. CLAIR AVE., CLEVELAND 17, OHIO

PUBLIC WORKS for March, 1961

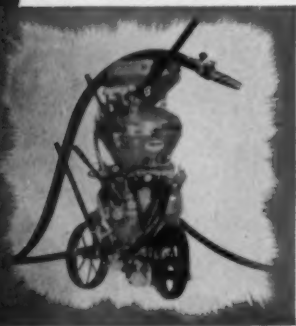
# CONCRETE COSTS GO DOWN ! WHEN YOU MOVE UP WITH

## AIRPLACO

"ADVANCED DESIGN" CONCRETE GUNNING EQUIPMENT

Field Engineered and Field Proved . . .  
Best For All Concrete Restoration and Construction.

WHEN THE JOB CALLS FOR CONCRETE . . . CALL FOR AIRPLACO



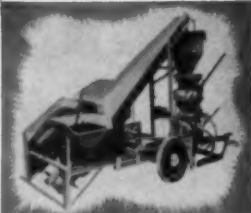
**AIRPLACO CONCRETE GUNS** for Restoration and Repair of Roads, Streets, Bridges, Culverts, etc. Choose from six different models in a complete line of concrete guns. Whatever your production requirements—from ½ to 8 cu. yds. per hour—there is an AIRPLACO BONDACITOR or NUCRETOR to meet your needs.

### AIRPLACO MIX-ELVATORS

for Faster, Easier Proportioning, Mixing, Elevating and Screening. Choose from three models. Capacity up to 12 yds. per hour.

### AIRPLACO GROUTER AND PLACER

for Easy-to-Use, Versatile Grouting and Placing of Concrete and Other Materials. The portable Model G-6 Grouter and CP-10 Placer is ideal for soil stabilization, tunnel backfilling, filling hard to get to forms, etc. Both the G-6 and CP-10 have capacities of up to 5 cu. yds. or more depending on materials used and job conditions.



**AIRPLACO JET-BLASTERS** For Low-Cost, Easy-to-Use Sandblasting (wet or dry). The Model B-6 single charge (650-lb. capacity) and B-3C continuous feed (500-lb. capacity) Jet-Blasters are designed to handle all abrasive materials for cleaning, polishing, or etching of any type of surface. Jet-Blasters are available with accessories for wet or dry blasting and new exclusive "Sand-Saver" remote cut-off valve.

Let Us Help You Solve Your Concrete Problems. Our experience in solving unique problems involving the handling of concrete has saved thousands of dollars for others. This experience is available to you. Write, wire or phone us, anytime.



WRITE FOR FREE CATALOG

## AIRPLACO

## AIR PLACEMENT EQUIPMENT CO.

1013 WEST 25TH ST. • KANSAS CITY 8, MO.

WORLD'S LEADING MANUFACTURER OF "ADVANCED DESIGN" PNEUMATIC PLACING EQUIPMENT

### CONCRETE TECHNOLOGY

This volume is a part of the celebration of the 50th anniversary of the founding of Kaspar Winkler & Co., the first of 16 independent Sika companies throughout the world. The many useful articles on concrete technology are printed in six languages—German, French, Italian, English, Spanish and Portuguese. The six sections in the various languages have summaries of each article in the other five languages. Due to the size (444 pages) and apparent cost of this book, copies are probably not widely available. Information can be obtained from R. K. Lockwood, Sika Chemical Corp., 35 Gregory Ave., Passaic, N. J.

### BROCHURE FOR A CONSULTING ENGINEER

The Consulting Engineers Council has prepared and issued a 24-page booklet "Preparation of a Consulting Engineer's Brochure." It contains ideas gathered from the published brochures of a number of consulting engineer publications and is intended to acquaint engineers with the possibilities in this field of public relations and to provide a blueprint for procedure. While it is "available to member firms," others might wish to sample this production of the Consulting Engineers Council, Reisch Bldg., Springfield, Ill.

### CENTRIFUGAL PUMPS

This is a practical and very complete book for users and designers of centrifugal pumps. It covers the entire field of centrifugals and their appurtenances and controls. There are five chapters: Pump types and construction, with classification and nomenclature; pump performance; controls, drivers and priming; service and selection; and installation, operation and maintenance. By Igor Karassik and the late Roy Carter. 496 pages; \$15.75 from F. W. Dodge Corp., 119 West 40th St., New York 18, N. Y.

### DOUGLAS FIR PLYWOOD STANDARDS

This booklet contains the U. S. Commercial Standard CS 45-60 for Douglas Fir Plywood. Some changes have been made as compared with previous standards. These include specifications and procedures for scarfing and for underlayment. Also some grades have been added. 20 pages. Douglas Fir Plywood Ass'n., 1119 A St., Tacoma 2, Wash.

PUBLIC WORKS for March, 1961

# Standby engine covers water district emergencies

TRAILER-MOUNTED INTERNATIONAL ENGINE IS "ON CALL" TO RELIEVE POWER PROBLEMS ANYWHERE IN THE MARIN, CALIF. WATER DISTRICT

The Marin Water District serves 95,000 people on the Marin Peninsula north of the Golden Gate. The district includes Hamilton Air Force Base and the prison at San Quentin, both big volume consumers. Water flows from mountain lakes through six main line transmission stations at about 25,000 gallons per day. The International UV-549 and Jacuzzi 8-inch pump can substitute for any of these stations, or function anywhere in the system.

"This engine saved us when the main booster pump on the line into Hamilton Air Base went out," reports Maintenance Foreman Byron Cook. "It took about three hours to weld a by-pass line around the useless motor. Then our International V-8 pumped steadily for 30 days until repairs were completed." In another emergency, during the dry summer of 1959, the International engine-pump-trailer combination followed receding lake levels and pumped 'round the clock for two weeks to maintain water pressure.

Power loss is no problem when a dependable International engine is standing by. That's why so many municipal officials insist on IH power for heavy-duty full-time applications, as well as standby service. There are 35 engines in the International line—16.8 to 385 max. hp—natural gas, LP gas, gasoline or diesel; stripped engines to complete power units. For complete information and installation assistance, see your nearby International Engine Distributor or Dealer.

**INTERNATIONAL<sup>®</sup>**  
**IH ENGINES**

International Harvester Co.,  
180 North Michigan Ave., Chicago 1, Ill.  
A COMPLETE POWER PACKAGE





# CLEAN WATERS...

Johnson Motors Photo

## **an investment, not a cost**

For they attract new industries, increase payrolls and property values and enhance the usefulness of public recreational facilities such as boating, fishing and bathing. Helping America clean up its polluted streams and lakes has long been the privilege of the Trickling Filter Floor Institute, by encouraging new sewage and industrial wastes treatment works employing trickling filters.

## **Why Trickling Filters Serve Best**

Economy, efficiency and ease of future expansion distinguish trickling filters. Many such plants built 30 and more years ago operate as well today as when first constructed. With TFFI Specification clay underdrains they offer 11 major advantages that any TFFI member will be glad to outline.

**TFFI**



## TFFI Specification Underdrains Surpass

Vitrified clay floor blocks give maximum resistance to acids, alkalis and bacteriological action. So reliable are they in service that TFFI manufacturer-members give a unique 50-Year Guar-

antee. For their blocks are made in modern plants under quality controls so rigid that no substitute materials can even approach them. Clay makes *final* cost of floors the *lowest* cost.



### Demand CERTIFIED Underdrain Blocks

Vitrified clay block manufactured by TFFI members and tested by the Materials Testing Laboratory of Rose Polytechnic Institute comply with or exceed ASTM Specification C159-59T. For your copy write nearest TFFI member.

Carlsbad, N.M.  
TFFI block floored  
trickling filter

Consulting Engineers, Ashley G. Classen  
& Associates, El Paso, Texas  
Contractors, Burn Const. Co., Las Cruces, N.M.

Distributor arms by Dorr-Oliver, sluice gates by Armco Drainage and Metal Products, Inc., cast iron pipe by James B. Clow & Sons



**DICKEY**  
W. S. Dickey Clay Mfg. Co.  
P.O. Box 2028  
Kansas City 42, Mo.



**TRANSLOT**  
Texas Vitrified Pipe Co.  
Mineral Wells, Texas

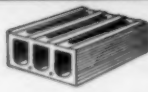


**NATCO**  
Natco Corporation  
327 Fifth Avenue  
Pittsburgh 22, Pa.

## Trickling Filter Floor Institute



**TRANSLOT**  
Cannelton Sewer Pipe Co.  
Cannelton, Indiana



**POMONA**  
Pomona Terra-Cotta Co.  
Greensboro, No. Car.



**ARMCRE**  
Ayer-McCord Clay Co., Inc.  
Brazil, Indiana



**BOSCO**  
Bowerston Shale Co.  
Bowerston, Ohio

# ALLIS-CHALMERS



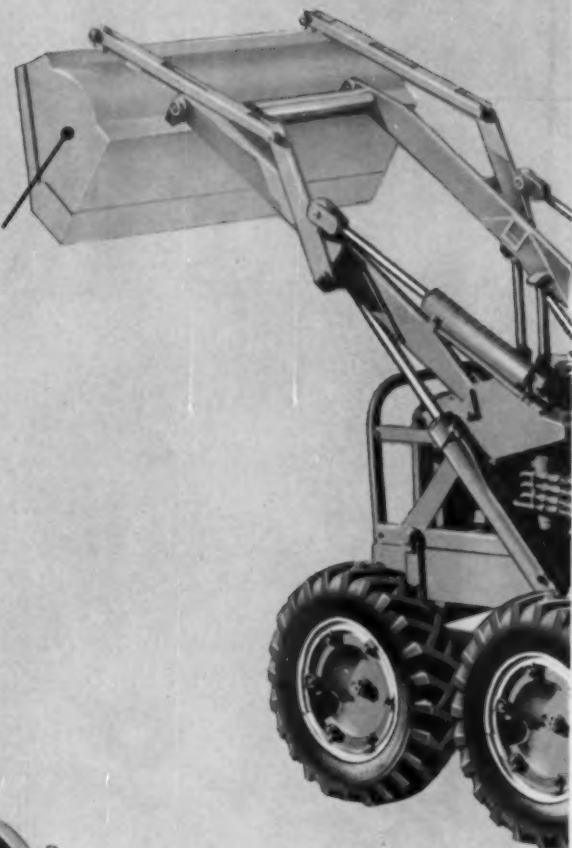
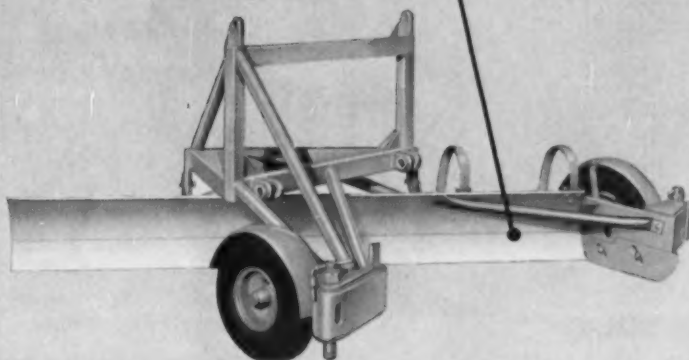
58 NET ENGINE HP

## HANDLES UTILITY LOADING

- 1** Does the thousand and one jobs that usually require special machines. Rugged  $\frac{3}{4}$ -yd bucket operates hydraulically. Lets you load out excess material while finishing work is going on.

## MAINTAINS SHOULDERS IN ONE SAFE PASS

- 2** Lets one man rebuild and maintain miles of shoulder every day. Grader blade levels shoulder, fills voids — maintainer blade spreads excess material — trailing striker blade clears highway edge — all in ONE PASS, with the machine safely off the road. The  $\frac{3}{4}$ -yd bucket is interchangeable with the maintainer.



# ONLY 4-IN-1 GRADER

The Allis-Chalmers Model D grader and its attachments give you timesaving, money-saving flexibility . . . not only for grading, but for loading, scarifying, and maintaining road shoulders, too.

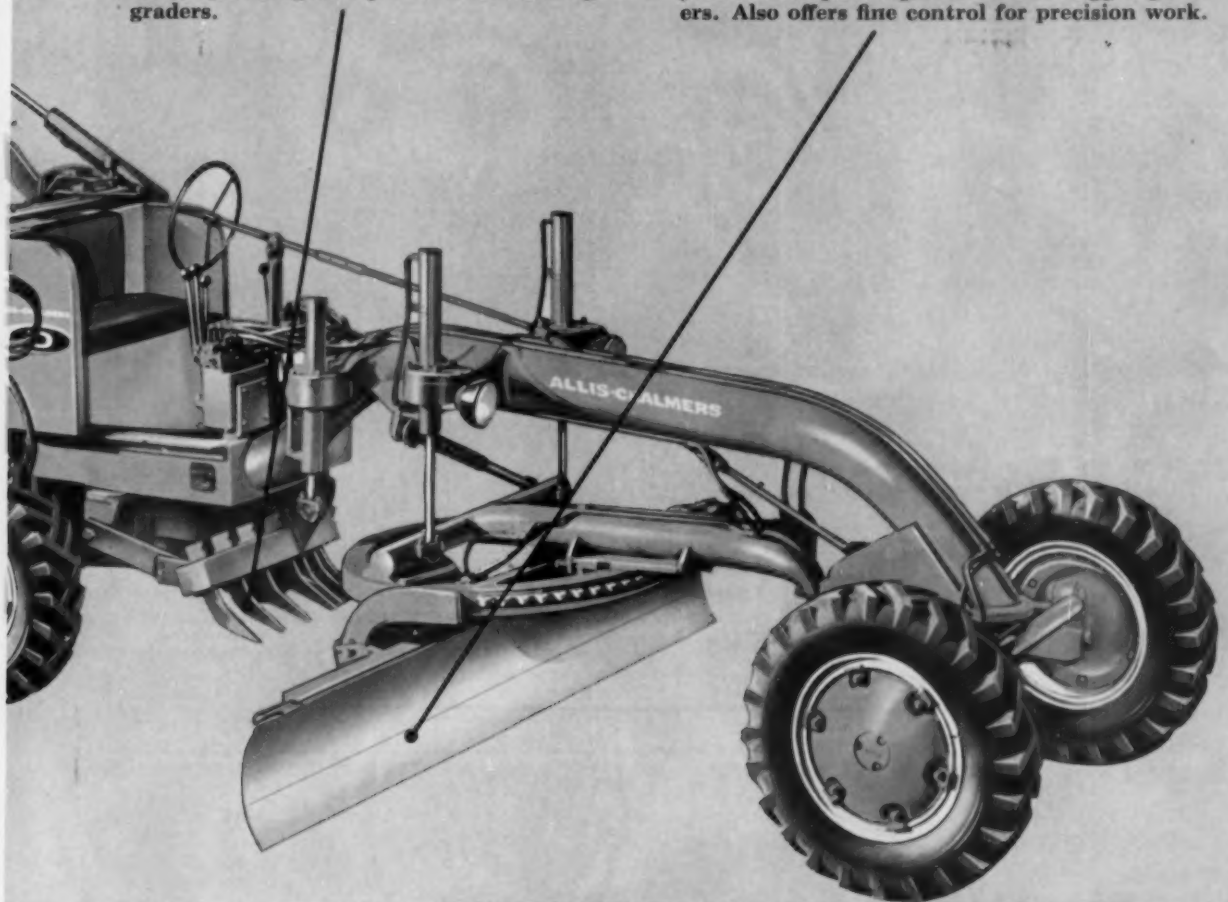
**move ahead with**

**SCARIFIES TOUGH,  
HEAVYWEIGHT MATERIALS**

**3** Seven-tooth design cuts 27½-in. swath, with 4,900-lb penetrating force. Mid-ship-mounted to allow good steering while working. Will scarify material on which you might expect to use the big graders.

**BIG GRADING CAPACITY  
WITH Roll-Away MOLDBOARD**

**4** Designed to lift and roll loads. Handles more dirt than ordinary blades, yet requires no additional power. With this exclusive moldboard, the Model D will roll loads as big as those you're now pushing with much bigger graders. Also offers fine control for precision work.



*Now available in Persian Orange or Allis-Chalmers Yellow at no extra cost.*

## YOU CAN BUY

Up front, the D is a grader — capable of tackling all your road and street work. Attachments add many practical uses — let you put a D on other jobs when grading is finished. Flexibility like this is bound to make a tax dollar go further.

A Model D costs less right from the start. It's scaled to your budget — so low, in fact, that you

can own two or three for what a big machine would cost.

You're invited to personally check the D's ability to handle your community's jobs. Your dealer will arrange a demonstration.

Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

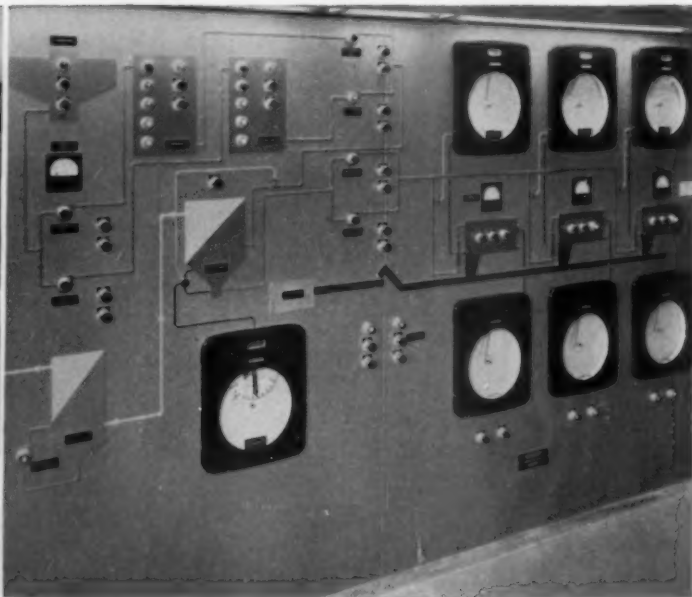
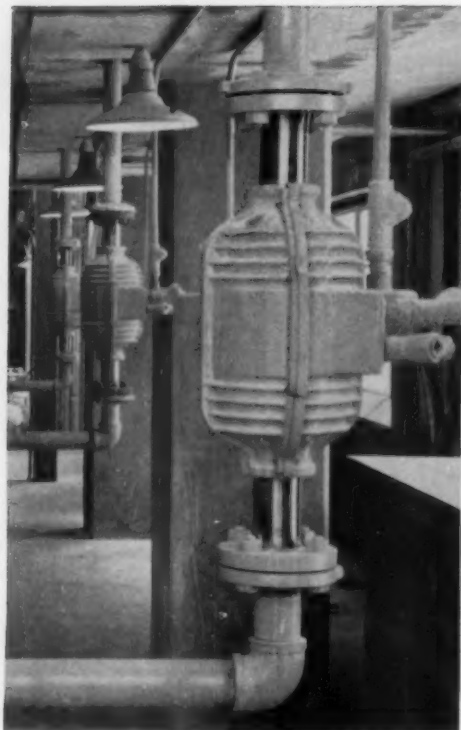
# ALLIS-CHALMERS



Roll-Away is an Allis-Chalmers trademark.

## power for a growing world

## Foxboro Magnetic Flow problems for



**DAYTON, OHIO** Three Foxboro Magnetic Flow Meters measure flow of sludge to centrifuges at Dayton's Lime Recalcining Plant. Designed around these meters, plant actually recovers up to 20% more lime than originally added to water. Graphic control panel in Feed End Building operates entire plant.



**NEWPORT, R. I.** At Newport, R. I. influent at the main sewage plant comes from both the town and a nearby Navy base. Determining how much of the total should be billed to the Navy is the job of the Foxboro Magnetic Meter and Foxboro Dynalog Recorder shown above.





# Meters eliminate line restriction these municipal utilities

Introduced six years ago, the Foxboro Magnetic Flow Meter has proved its superiority for measuring water, sewage, sludge and other treatment plant flows.

Foxboro Magnetic Flow Meters have no flow restrictions of any type. No taps to get plugged or frozen, no seals or purges, no moving parts of any type. Measurement is made by electrodes flush-mounted in meter wall—then transmitted by electric cable to a Foxboro Dynalog\* electronic recorder. Accuracy is  $\pm 1\%$ .

Foxboro Magnetic Flow Meters have solved some of the toughest municipal measurement problems. Ask your Foxboro field engineer to show how it can help with yours. Or write for Bulletin 20-14. The Foxboro Company, 263 Norfolk Street, Foxboro, Massachusetts.

\*Reg. U. S. Pat. Off.

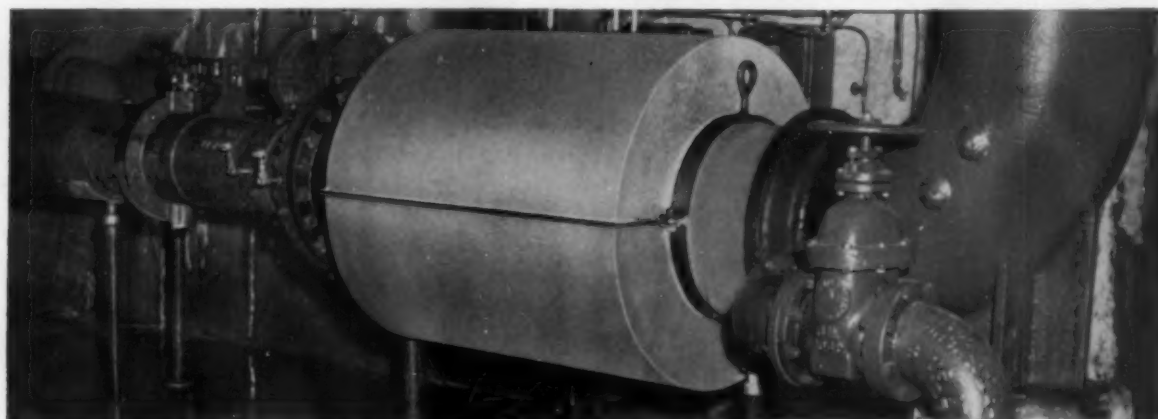
## Partial List of Progressive Communities Using Foxboro Magnetic Flow Meters

Benton Harbor, Michigan . . . . .	— raw sewage
Hayward, Calif. . . . .	— water
Pittsburgh, Pa. . . . .	— raw sewage
(Allegheny County Sanitary Authority)	
Covington, Ohio . . . . .	— return activated sludge
Medfield, Mass. . . . .	— water
Orange County, Calif. . . . .	— sewage
Warren Township, Michigan . . . . .	— raw sewage and sludge
Bloomfield Township, Michigan . . . . .	— water
Seattle, Washington . . . . .	— sludge
(Lake City Sewage Plant)	
Milwaukee, Wisconsin . . . . .	— sludge
Piqua, Ohio . . . . .	— sludge
Arkansas City, Kansas . . . . .	— sewage
Sidney, Ohio . . . . .	— return activated sludge
Frazer, Michigan . . . . .	— raw sewage

Meter sizes on these installations range from 3 inches to 6 feet.



**FARMERS BRANCH, TEXAS** Eight-inch Magnetic Flow Meter at a sewage lift station. Meter was installed below ground level, right next to elbow and valve, without affecting its measurement accuracy.



**CHICAGO, ILLINOIS** This 20" Foxboro Magnetic Flow Meter was installed in the South District Filtration Plant in April, 1956. Because it has no line restrictions, plant officials knew the meter would add no more pressure drop than an equivalent length of pipe. Note how it was installed directly downstream from an elbow.


# FOXBORO

REG. U.S. PAT. OFF.



*Get set for higher production—lower costs with new*

## 3010 Wheel Power

 Now—cut the big jobs down to size with an all new 65 engine horsepower John Deere "3010." Move into tough loading and material handling assignments with this smooth-handling wheel loader; tackle major trenching jobs confidently with a "3010"-powered John Deere backhoe.

**New Operating Ease:** Convenient controls boost productivity of the heavy-duty "3010" Wheel Loader and power-matched backhoes. Single-lever control operates loader lift arms and bucket for rapid handling.

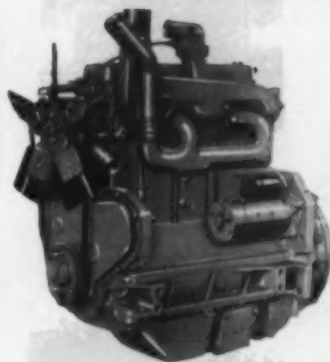
John Deere backhoes operate with simple two-lever control. Flush-digging model 51 has rotary boom cylinder which centers or slides to any of four off-center positions, moved by the unit's own hydraulic power.

**Gasoline or Diesel Power:** All-new John Deere 4-cylinder, 4-cycle overhead valve engines feature cam-ground aluminum pistons, high-turbulence combustion chambers for thorough fuel-air mixing, top efficiency. Replaceable-sleeve design for easy servicing. Large manifold insures free breathing at every speed. Exclusive forced engine ventilation. Full-pressure lubrication system with full-flow oil filter. Exhaust-valve rotators.

**Modern Platform, Control Design:** Clean, functional "command post" assures all-day operator comfort and efficiency. Deluxe seat adjusts to operator's weight. Large clear platform makes mounting, getting down, fast and easy. Hydraulic controls conveniently located for smooth operation. Constant mesh transmission—8 speeds forward and 3 reverse, for any power requirement. Power steering, power brakes. Low-profile design provides high machine stability, excellent operator vision.

For a demonstration of new John Deere "3010" Wheel Power, contact your John Deere Dealer through the yellow pages of your telephone directory.

John Deere • 3300 River Drive, Moline, Illinois



# JOHN DEERE

LOADERS BULLDOZERS BACKHOES  
AND EARTHMOVING EQUIPMENT



# EQUIPMENT and MATERIALS FOR YOUR PUBLIC WORKS PROGRAM

## NEW LISTINGS

### Even Parshall Flumes Can Be Improved!

538. And now they are. Just how, with new polyester resin bond, is covered by this fact-sheet describing the new advantages offered you in sizes from 3-inch through 24-inch throat widths. Light weights for easy handling is an added feature. Write for Bulletin 802 to Simplex Valve & Meter Co., 7 E. Orange St., Lancaster, Pa., or circle number on card.

### An Incinerator that Small Cities Can Afford

541. Informative folder shows how smaller cities and major institutions and industries alike are getting low costs and high efficiency with simple low cost Wilco Teepee Refuse Burners. Dimensions, specifications and descriptions included. For your copy address Wilco Machine Works, Inc., Box 3722, Memphis 14, Tenn.

### Best Way to Beat the Long Haul Problem on Refuse



547. . . . is fully described and illustrated in this new folder. Tells how your Dempster equipment containers can be converted for super-service. Gives you the step-by-step process to modernize what you have now. Write for Folder 6073 from Dempster Bros. Inc., Knoxville 17, Tenn., or just circle the number on our card.

### Reinforced Plastic Pipe and Fittings

549. . . . for water and sewage service, in sizes 2 through 8 inches, made of epoxy resins and glass, highly resistant to hydrogen sulfide gas, electrolysis and difficult soil conditions. Booklet tells all in 16 illustrated pages. For your copy write Amercoat Corporation, 4809 Firestone Blvd., South Gate, Calif., or circle number on the card.

### Genuine Wrought Iron for Sewage Treatment Installations

551. Is the title of a most attractive, color-cover illustrated technical booklet describing wrought iron installations in many prominent sewage plants throughout the country. You will find it valuable when designing the next plant. Write for it by name to A. M. Byers Co., Clark Bldg., Pittsburgh 22, Pa., or check our card-number.

### Ball Joint Pipe for River Crossings

562. And other tough pipe-laying situations are theme of this well-illustrated booklet on MOLOX joint pipe. Contains map showing various locations of such installations, with suggestions for use and methods of assembly. Complete data on all diameters. For your copy, write American Cast Iron Pipe Co., Box 2603, Birmingham 2, Ala., or circle our card-number.

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field of cities, counties or states.

### Chronoflow Telemetering

552. . . . is the subject of a new 8-page book about this type of equipment and systems. Pictures and describes Chronoflow transmitters and receivers, as well as accessories. Applications for it are briefly listed to make the brochure of greatest value to design engineers. Write for it by Reference No. 230.20-2 to B-I-F Industries, 345 Harris Ave., Providence, R. I., or circle our number on card.

### Chemical and Slurry Feed Pumps

560. . . . are described in new booklet by that title which carries descriptions, illustrations and specifications of value in choosing such pumps. Write to Komline-Sanderson Engineering Corp., Peapack, N. J. Or you may check our card number for it.

### Waterspheres and Waterspheroids

563. Modern designs in elevated steel tanks—are described in 16-page brochure with photographs and tables of standard sizes. For your copy, write Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago 4, Ill., or circle the number on our reply card.

### Judging Engine Quality

565. . . . may be hard but this 26-page booklet emphasizes the features of various designs which provide you with top engine performance for minimum cost—original and or final. Cutaway illustrations compare these features for quick grasp of their importance. Write for Form 20185-DN935 to Caterpillar Engine Div., Peoria, Ill., or just check off our card-number.

### In Tapping Machines Progress Never Ends

566. Now the B-100 double pressure chamber machine is available as described in new folder. Learn now what it can do for you by writing for Bulletin 8912 to Mueller Co., 512 W. Cerro Gordo, Decatur, Ill., or by circling our card-number.

### A New Submersible Dewatering Pump

573. . . . is described and illustrated, and specifications given in this new folder. Many questions answered also. To get your copy write The Gorman-Rupp Co., Mansfield, Ohio, or check off number on the card.

### Answers to Questions on Epoxy Paving Compounds

558. Is contained in 20-page booklet that discusses fully the advantages of Resiweld Guardkote No. 140 surfacing on roads, bridges, ramps and highwear sections of old pavements. Includes answers to every question on where, when and how to use, on new construction and in repairs. Ask for Technical Bulletin RTB-11 G from H. B. Fuller Co., St. Paul 2, Minn., or circle number on card.

### Planning for Concrete Placing

564. . . . with latest knowledge of equipment available for this work. Three circulars available describe a pneumatic pressure grout; a Hydra-Jak which is a combination of a mud-jack and sand and cement Grouter; and a Uni-Cretor for gunning and pumping various mixes. For yours write Air Placement Equipment Co., 1000 W. 25th St., Kansas City 8, Mo., or ring our number on card.

### Something New in the Incinerator Field

577. A reciprocating grate stoker described and illustrated. Brochure shows how it provides new answers to old incinerator operating problems. Just write for Pamphlet 701 to Detroit Stoker Co., Monroe, Mich., or circle number on the card.

### Public Works Equipment for Everyday Use

578. How many everyday public works needs can be met by the products of one company is the basic content of this brief but informative brochure. Inform yourself with a copy of it. Address Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wisc., or ring the number on card herewith.

### Metering Pumps

580. Get the full treatment in twin brochures filled with valuable data to the water works head who is on the lookout for all that is new in good chemical feed pumps. For yours, address Wallace & Tiernan, Inc., Belleville 9, N. J., or check our card-number.

### Compactors—A Manual on their Use and Application

581. Information on the various types of compaction equipment in use today, including rollers and vibratory compactors, is presented and discussed in detail. Special attention to maintaining efficient compaction of various materials plus correct use of communications equipment available. Address The Galion Iron Works & Mfg. Co., Galion, Ohio, or check our card-number.

### Trickling Filter Media

582. New booklet contains data on applications in waste treatment of DOWPAC. Describes properties, design and installation and performance data. This complete information can be had from The Dow Chemical Co., Plastics Sales Dept., Midland, Mich., or circle number on card.





**OWNER:** Ohio State Highway Dept., Columbus, Ohio. **PROJECT:** O. S. H. Project # 561, Cuyahoga County, Ohio. **CONTRACTOR:** Bates & Rogers Construction Corp., Chicago. **PIPE:** 48" Ex. Str. steel-reinforced concrete culvert pipe, fully lined with vitrified clay plates.

## Bring on your acids . . . this U. S. vitrified plate-lined concrete pipe can take it!

United States concrete pipe with vitrified clay plate lining provides you the greatest possible assurance of long service life and protection against abrasion and attack by severe sewerage and industrial waste acids and alkalis.

Liner plates are precision formed for exact fit with pipe curvature. All joints are formed with acid-resistant cement. • The next time you have a concrete pipe project which calls for maximum protection against corrosion, specify U. S. vitrified clay-lined pipe. Meantime, send for full details and engineering data.

2011



**UNITED STATES CONCRETE PIPE CO.**

A SUBSIDIARY OF PITTSBURGH COKE & CHEMICAL COMPANY

1500 Union Commerce Building • Cleveland 14, Ohio • Telephone MAIn 1-5240

Sales Offices: Baltimore • Pittsburgh • Philadelphia • Cincinnati • Ft. Lauderdale • Ocala • Kalamazoo

To order these helpful booklets check the reply card opposite page 34.

## NEW LISTINGS (Cont.)

### Pavement Striping that Defies Rain or Fog

583. What street and highway engineers have long sought is here now—extra-brilliant, extra-durable reflective surface for traffic lines. Described in booklet on LITE-LANE Traffic Guide System. Write Dept. A & P, American-Marietta Co., 3400 13th Ave., S. W., Seattle 4, Wash., or ring our number on card.

### Ball Valves

584. For automatic pump stop and check service, pressure regulating, and strategically located shut-off applications. Get the full story by writing for "List 26" to Willamette Iron & Steel Co., 2800 N. W. Front Ave., Portland 10, Oregon, or check our card-number.

### Rapid Sand Filter Control

589. New! A 4-page illustrated bulletin describing the operation of sand filter controls in modern automatic water plants. Shows in detail a complete pneumatic filter control system with auxiliary instrumentation. Write for Bulletin 450, to Bailey Meter Co., 1050 Ivanhoe Road, Cleveland 10, Ohio, or circle our card-number.

### Large Capacity

#### Submersible Pumps

590. With corrosion resistant bronze and stainless steel construction are described in new 8-page Bulletin B1400. Water or oil lubrication, according to type and local requirements to be met. Address Sumo Pumps Inc., Brown House Road, Stamford, Conn., or just check our card.

### How to Use

#### Lime in Asphalt Paving

591. . . and its advantages is the subject of this new fact-packed 16-page booklet No. 325. Replete with illustrations and test data related to field projects in western U. S. Get your copy from The National Lime Association, 925 15th St., N. W., Washington 5, D. C., or check number on our card.

### A New Drilling Machine for Cuts in Pipe

589. Automatic, cuts up to 12"; and can be successfully operated even by inexperienced personnel to give faster, safer cuts. Take a minute to get this new folder 8881 from Mueller Co., 512 W. Cerro Gordo, Decatur, Ill., or just circle number on our card.

### "Straight Line Sludge Collectors"

592. An important 28-page booklet, No. 2746, just out gives new data, describing a complete line of sludge collectors for rectangular settling tanks. Remarkably complete and informative. For yours, address Link-Belt Co., Dept. PW, Prudential Plaza, Chicago 1, Ill., or check our card-number.

### Here's Help in Fighting to End Water Pollution

593. A practical, attractive promotion kit is offered showing how to promote successful bond campaigns to finance clean waters programs for your community. Contains literally everything you need and can use. For yours, address Portland Cement Association, 33 West Grand Ave., Chicago 10, Ill., or circle our card-number.

### Three New Sewer Rodding Machines

594. Just announced and worthy of your attention. Literature describing them and their new features will be a valuable guide for your sewer rodding operations. To secure it address Flexible, Inc., 415 S. Zangs Blvd., Dallas, Texas; or circle our card-number.

### Don't Cover Up Odors, Kill Them

597. New information sheet available that tells what Sani-Septic concentrate can do in roadside, parks and rest areas to render them inoffensive. For your helpful copy just write Werley Chemical & Supply Co., 1505 Broadway, Cleveland 15, Ohio, or check number on card.

### For Easy Reference on Contractors' Pumps

598. . . get the McGowan bulletin on a complete line suited to all municipal needs. Self-priming models in 1-in. to 8-in. size, light weight and heavy duty, centrifugal and diaphragm types. Write McGowan Pump Division, Leyman Mfg. Corp., 10900 Kenwood Road, Cincinnati 42, Ohio.

### Variable Pitch Rotaries for all Mowing Requirements

601. The Roof VP Mower with blade pitch adjustment for different cutting conditions handles all mowing chores from dense weed removal to park lawns. Check this heavy-duty equipment for your turf maintenance needs. Data from Roof Mfg. Co., 1228 North Walnut St., Pontiac, Illinois, or check the reply card.

### Kohler Stand-by Units

#### Protection Against Power Failures

602. Dependable Kohler electric plants provide uninterrupted power for vital services when regular sources fail. Kohler Electric Plants World-Wide, folder E-402, illustrates models available for stand-by, sole supply, portable and marine applications. Sizes from 500 watt to 115 kw, gasoline, gas or Diesel operation. Write Kohler Co., Kohler, Wisconsin, or use the reply card.

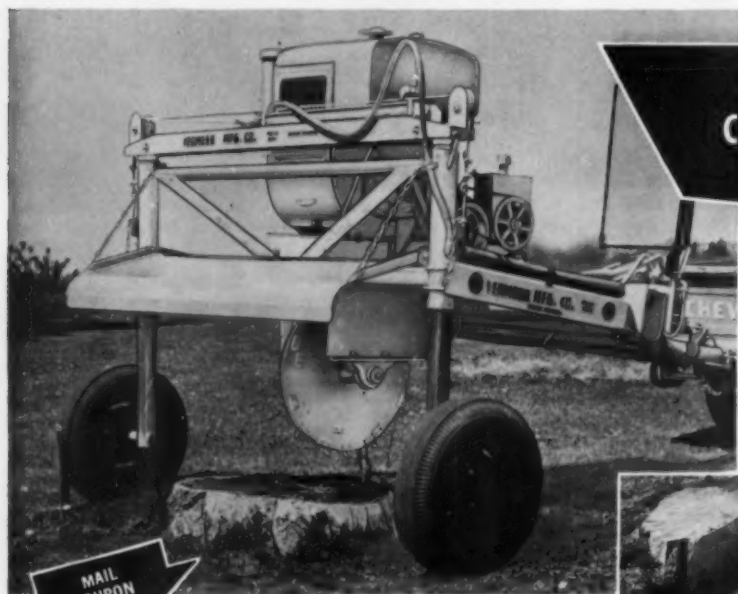
### New . . . a 2-Color Portable Pavement Striper

604. Description is yours on request of how new Wald Tandem Tanker converts a standard model Wald into a two-color machine. Outlines how it doubles paint capacity along with many other attractive features. Write Wald Industries Inc., Huntingdon, Pa., or use our check-card.

### Steel Buildings

#### Offer Economical Construction

605. Details on pre-engineered steel buildings of many types, suitable for garage, maintenance headquarters and other municipal needs, are provided in drawings, specifications and photographs offered by Brookville Mfg. Co., Brookville, Pa. Get this helpful information by checking the reply card.



HERE'S HOW 800 CITIES SOLVED THEIR STUMP PROBLEM...

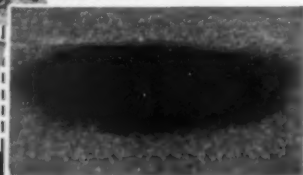
Original Low Cost VERMEER

## POW-R-STUMP CUTTER

### Rips Stump To Shreds In Minutes!

You'll save hundreds of back-breaking man-hours and thousands of dollars annually . . . with a Vermeer Pow-R-Stump Cutter. The choice of tree experts everywhere! It's the modern way, the economical way to remove ugly stumps. Mail the coupon for all the details . . . and a FREE demonstration.

Photos show how big revolving cutting wheel rips stump to chips . . . down to 10" below the ground. Dirt is replaced, chips removed and area is ready for seed or sod.



MAIL COUPON TODAY

Send complete descriptive literature and prices on your Pow-R-Stump Cutter to

NAME.....  
TITLE or DEPT.....PHONE.....  
FIRM.....  
ADDRESS.....  
CITY.....STATE.....



VERMEER MANUFACTURING COMPANY

1439 W. WASHINGTON, PELLA, IOWA

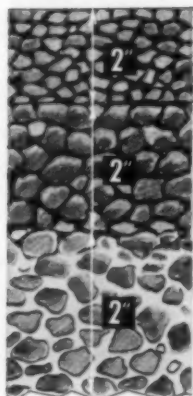
Registered Under U. S. Patent No. 2912022

# FOUND!

A winning combination: Asphaltic concrete made with Chevron Asphalt over a Dilute Bitumuls Treated Base.

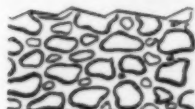
*For "Deep-Strength" Construction PLUS Economy!*

**Realignment of U. S. Route #99 (Pacific Highway) between Albany and Eugene, Oregon, involves construction of twelve miles of new, heavy-duty pavement.**



4 inches Asphaltic Concrete made with Chevron Asphalt; laid in 2 lifts as indicated.

Top 2 inches of crushed stone base treated with diluted Bitumuls; then compacted.



Compacted base stone

The original "specs" called for construction of a compacted stone base, surfaced with 4 inches of asphaltic concrete. As a result of preliminary tests, however, a Field Change Order was issued specifying treatment of the top 2 inches of the base with an economical nine-to-one dilution of Bitumuls.

Dilute Bitumuls Treatment "controlled" the top of the base during surfacing; provided water-resistance that contributed to an overall stronger pavement. Over the base, two lifts of asphaltic concrete made with Chevron Asphalt were placed to complete the construction.

The job is under the direction of the Oregon State Highway Department. The contractor, Warren Northwest, Inc., has done a fine job of coordinating all phases of the job. One key factor in maintaining operations on schedule has been the dependable, on-time service on Bitumuls and Chevron Asphalt deliveries.

*Call office nearest for details on how Bitumuls Emulsified Asphalts and Chevron Paving Asphalts can be combined to give you better pavements at lower cost.*



**Dilute Bitumuls-Treated Base**



**Surfacing (made with Chevron Asphalt)**



**American Bitumuls & Asphalt Company**

320 MARKET, SAN FRANCISCO 20, CALIF.  
Perth Amboy, N. J.  
Baltimore 3, Md.  
Cincinnati 38, Ohio

Atlanta 8, Ga.  
Mobile, Ala.  
St. Louis 17, Mo.  
Tucson, Ariz.

Portland 8, Ore.  
Oakland 1, Calif.  
Inglewood, Calif.  
San Juan 23, P. R.

BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts



To order these helpful booklets check the reply card opposite page 34.

## WATER WORKS

### Equipment For Water, Sewage and Industrial Waste Treatment

24. The complete line of Jeffrey equipment for treatment plants is covered in a 64-page Catalog 952 available from The Jeffrey Mfg. Co., Columbus 16, Ohio. Check the reply card for information on bar and disc type screens, traveling water screens, grinders, grit collectors, garbage grinders, sludge, draw-off valves, chemical feeders, bucket elevators and scum removers to mention some of the equipment.

### Catalog on Synchronous Motors and Controls

64. A 27-page Catalog B-7292 on synchronous motors and controls is well illustrated and contains motor selector charts, application data, and formulas for calculating power factor. For a copy write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., or check the reply card.

### For Fast, Smooth Pipe Cuts

68. Descriptive literature on the Reed 4-wheel binged pipe cutter which operates in close quarters, gives quick, easy right-angle cuts, and is available from Reed Mfg. Co., Erie, Pa. Check the reply card.

### 100 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH, Chlorine and Phosphate Control and descriptions of comparators for making colorimetric analyses. A 100 page booklet is available by checking reply card. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

### High Frequency Resistance—Welded Steel Pipe.

72. Available in 6" to 16" diameters, in wall thickness to .219, special wrappings and coatings available. For attractive booklet, including specifications and details of field joints write Valley Mfg. Co., Valley, Neb., or circle our inquiry card.

### Rapid Sand and Pressure Filter Data

109. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden gravity filters, and filter tables and other equipment. For engineering data, write Roberts Filter Manufacturing Co., 640 Columbia Ave., Darby, Pa., or check the reply card.

### Facts About Transite Pipe for Water Mains

121. Engineers can secure four pieces of illustrated literature that cover installation, operation and maintenance economies of Transite and Ring-Tite couplings for pressure mains. DS-335 is a material specification. TR-15A a Friction Loss of Head and Flow Powergraph, TR 62A an Installation Guide, and TR-160A in-service characteristics and case histories of water pipe. Tables of weights, sizes, pressure classes included. Address Johns-Manville, 22 E. 40th St., New York 16, N. Y., or check above number on card.

### A Handy List on "In Stock" Pipe

148. . . . is issued monthly by L. B. Foster Co. to show all stock footages of seamless and welded pipe, structural steel pipe and other specialties. Enables you to order pipe with exact knowledge of what is immediately available. Address L. B. Foster Co., P. O. Box 1647, Pittsburgh 30, Pa., or you can just check number on our card.

### Valve and Hydrant Construction Details

161. A 72-page catalog-type bulletin, just completed, gives detailed data on construction and application of gate valves, check valves and hydrants for water works service. Write for Bulletin 5710 from Darling Valve and Mfg. Co., Williamsport, Pa., or check the reply card.

### Design of Prestressed Concrete Tanks

194. An 8-page technical Bulletin, T-19, on the Design of Prestressed Concrete Tanks, gives engineering data and formulas of general interest to anyone considering prestressed concrete for storage tanks. Check the reply card or Write to The Preload Co., Inc., 355 Lexington Ave., New York 17, N. Y.

### Manual on Filter Bed Agitators

206. General information-specifications and installation data regarding the application of Palmer agitators, or rotary surface wash in vertical and horizontal pressure filters—round, square and rectangular open gravity type filters are covered in Manual from Palmer Filter Equipment Co., 822 East 8th St., P. O. Box 1696, Erie, Penna. Check the reply card.

### A Fully Rotary Compressor by Jaeger

209. Complete information is available from The Jaeger Machine Co., Columbus 16, Ohio on this 2-stage, oil-cooled rotary compressor. Features include 80% fewer moving parts, up to 30% less weight, vibrationless operation and 100° cooler air.

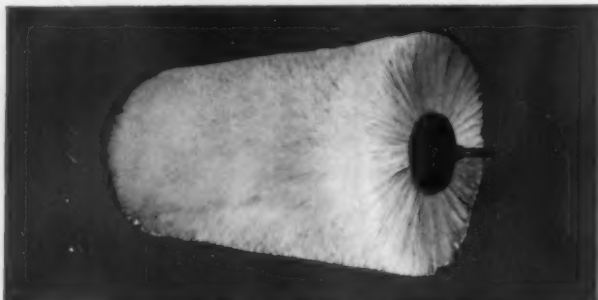
### When It Comes to Pumps

311. You will profit by having this 4-page condensed bulletin which illustrates and describes the Aurora Centrifugal and Apco Turbine Type Pumps with capacity ranges from 1 to 9000 GPM, and heads to 600 ft. Just write for your copy to Aurora Pump Div., The New York Air Brake Co., 630 Loucks St., Aurora, Ill., or circle number on card herewith.

## ROAD-TESTED Prostran®

Saves Jersey Town\* Up To 35%

YOU CAN SAVE THIS KIND OF MONEY ON YOUR STREET SWEEPING OPERATION, TOO!



### YOU GET THESE BENEFITS WITH PROSTRAN-POLYPROPYLENE STREET SWEEPING FIBRE

- Superior To Any Natural Or Synthetic Broom Material
- Reduced Cost Per Sweeping Mile
- Longer Lasting Use-Life
- Excellent Sweeping Efficiency
- Minimum "Down-Time" for Repeated Broom Filling
- Toughness and Superior Abrasive Action
- Excellent Flex-Life for Ideal Bend Recovery
- Excellent Resistance to Chemicals, Solvents, Greases, Oils and Many Common Acids
- Lightest Weight Of All Synthetics - More Bulk Per Pound
- Heavy Duty Efficiency and Clean Sweeping
- Top Performance Under All Weather Conditions

### DISTRIBUTED IN UNITED STATES BY:

**New England States**  
Atlantic Broom Service, Inc.  
60 McDonald Street  
Readville 36, Massachusetts

**Texas, Louisiana**  
Dallas Brush Mfg. Co.  
5108 N. Westmoreland  
Dallas 7, Texas

**U. S. A. - except as listed**  
Tuffibre Co., 17 Kearney St.  
East Orange, New Jersey  
Branch Warehouses Nationwide

### IN CANADA BY:

**Eastern Canada**  
Sicard, Inc.  
2055 Bennett Ave.  
Montreal, Quebec

**Manitoba, Saskatchewan**  
Atlas Brush Ltd.  
McDermot & Lydia Sts.  
Winnipeg 2, Manitoba

**Alberta, British Columbia**  
Brodie Brush Co., Ltd.  
891 Cambie St.  
Vancouver, British Columbia

\* Details on request

PHONE  
Burlington, Vt.  
UNiversity 4-7414



**E.B. & A.C.**  
**WHITING**  
**COMPANY**  
Burlington, Vermont



# UTILITY TUNNELS with VERSATILITY



On completion of Lo-Hed® tunnel at right, 48" aggregate conveyor system is installed.

132" Lo-Hed® conveyor tunnel being installed for Michigan Limestone Division of United States Steel Corporation at Rogers City.



91 in. x 91 in. Flat Base utility tunnel for New Jersey firm. Note smooth, watertight joints.



Hi-Hed® makes an ideal utility gallery—assures ample head-room in passage way.

## A-M PRECAST CONCRETE UNITS CUT INSTALLATION TIME AND COSTS

American-Marietta reinforced precast concrete pipe is available in a variety of shapes. This permits extreme versatility in the design of utility tunnels for carrying steam pipes, gas mains, electrical cables and telephone lines with enough room for workmen to make repairs. In addition to conventional round pipe, A-M offers LO-HED® with greater width under minimum cover; FLAT-BASE with "built-in" walk way; and HI-HED® for minimum vertical load and maximum lateral support under high fills. Find out how much installation time and money A-M Engineers can save on *your* job with precast pipe. Write today for information and literature.



**AMERICAN-MARIETTA COMPANY**  
**CONCRETE PRODUCTS DIVISION**

GENERAL OFFICES:  
AMERICAN-MARIETTA BUILDING  
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600



**Reliable, cost-saving  
independent power...**

## Kohler Electric Plants

Kohler electric plants have proved their rugged efficiency on new turnpike construction, building projects—wherever reliable power is needed for floodlights, power tools. Engineered for fast, all-weather starting, round-the-clock stamina on tough schedules where time means money . . . Sizes to 115 KW, gasoline and diesel, include compact, 4-cycle, air-cooled models . . . and emergency models for toll plazas, maintenance buildings when storms or accidents cut off normal power source . . . Write for folder L-27.

KOHLER CO. Established 1873 KOHLER, WIS.



MODEL SRM61,  
5000 watts, 115/230  
volt A.C. Remote start.

**KOHLER  
ELECTRIC  
PLANTS**

**KOHLER OF KOHLER**

ENAMELED IRON AND VITREOUS CHINA PLUMBING FIXTURES • ALL-BRASS FITTINGS  
ELECTRIC PLANTS • AIR-COOLED ENGINES • PRECISION CONTROLS

### Manual on Pipe

#### Finding Techniques

213. A manual on special pipe finding and leak detecting techniques of interest to utilities, municipalities, oil and gas companies is announced by Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif. The manual contains a number of articles on locating buried pipes and cables and detecting and locating fluid leaks in pipe lines.

### Meters and Instruments

#### For Water Works

224. An attractively arranged 40 page catalog in full color issued by Hersey-Sparling Meter Co., 225 No. Temple City Blvd., El Monte, Calif., furnishes concise data on the full line of Sparling meters, indicator-totalizer-recorder instruments and other special instruments and controls. Check the reply card for your copy, or write for Bulletin 314.

### Outline of Modern

#### Water Treatment Equipment

248. Bulletin 4433 is recommended for engineers who need a basic refresher course on treatment of municipal and industrial water. It lists water impurities and methods of treatment and illustrates treatment systems and equipment. Check the reply card or write The Permutit Co., a Division of Pfaunder-Permutit Inc., 30 West 44th St., New York 36, N. Y., for your copy.

### A Quick Comparison

#### of Water Meters Helps

274. That is the purpose of the new bulletin describing the newest accomplishments in water meter design and manufacture. With it comes a Condensed Catalog of the Rockwell line. Ask for Bulletin No. W-811 from Rockwell Mfg. Co., Municipal & Utility Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

### Cut Down Your

#### Underground Explorations

276. . . . for buried pipe by knowing where it is before you start digging for it. "Typical Pipe Detection Problems and Their Solution" is the title of a free 24-page illustrated, pocket-size book that tells you how to find and determine the depth of buried pipes, conduits, wires and cables. Address Computer-Measurements Co., 12970 Bradley Ave., Sylmar, Calif., or check above number on our card.

### Water, People and Hydrodynamics

302. . . . is the title of an illuminating booklet dealing with the world-wide problem of how to get water in adequate supply, when and where needed. Your copy can be had for the asking of Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill., or use the reply card.

### Learn About Positive

#### and Easy Valve Operation

304. "LimiTorque" Valve Operators provide push-button control that enables one man to open and close any type of valve quickly and dependably, provide full protection from damage during closing cycle due to torque limiting mechanism. LimiTorque is available for operation by any power source and is readily adaptable to all types of remote control. Catalog L-550 completely describes and illustrates operation and installation. Philadelphia Gear Corp., King of Prussia, Penn.

### Helpful Data on

#### Water Meters

330. It is to the interest of every water works superintendent and engineer to have full data on dependable Badger water meters and related meter products. Complete data on all types of disc, turbine and compound meters, meter test equipment, yokes, strainers and alarm registers are supplied in an attractive binder by Badger Meter Mfg. Co., Milwaukee 23, Wisconsin.

### Technical Bulletin on Swimming

#### Pool Filtration Equipment

335. A 24-page technical Bulletin 626, designed to help persons planning pools which must comply with local and state health regulations, is now available from the R. P. Adams Co., Inc., 328 East Park Drive, Buffalo 17, N. Y. Check the reply card for data on size selection charts, typical installations and drawings.

PUBLIC WORKS for March, 1961

# Fort Worth chooses Armco SMOOTH-FLO Pipe

**reduces costs and installation time**

Economical,  
Durable,  
Strong



Fort Worth, Texas, recently completed a 72-inch sanitary sewer main that had to cross under heavily-traveled Belknap Street and three railroad lines. Tunnels were constructed at these sites and Armco ASBESTOS-BONDED SMOOTH-FLO® Pipe was threaded inside the tunnels. SMOOTH-FLO was specified for two reasons:

1. The outside diameter of 72-inch I. D. SMOOTH-FLO Pipe is only about 73 inches, while the outside diameter of 72-inch I. D. rigid pipe is 88 inches. Since SMOOTH-FLO could be installed in a much smaller tunnel, considerable savings in material and labor costs resulted.

2. Lightweight SMOOTH-FLO Pipe is easier to thread inside a tunnel than heavier pipe, reducing installation time and expense.

How can Armco SMOOTH-FLO Pipe help you with your sewer problems? Fill in and mail the coupon. A qualified Armco Sales Engineer will be glad to call you for an appointment. No obligation, of course.

Armco Drainage & Metal Products, Inc.  
4571 Curtis Street, Middletown, Ohio

Have an Armco Sales Engineer call me for an appointment.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

New steels are  
born at  
Armco

**ARMCO** Drainage & Metal Products

To order these helpful booklets check the reply card opposite page 34.

#### Tips for Installing Orangeburg Pipe

336. Good practice for installation of Orangeburg pipe and fittings is outlined in an illustrated four-page bulletin made available by the Orangeburg Mfg. Co., Div. of The Flintkote Co., 375 Park Avenue, New York 22, N. Y. Trenching and backfilling, pipe laying, cutting and connecting.

#### Bulletin Covers Step-by-Step Action on the Water Problem

489. A step-by-step outline of action telling how the responsible citizens can help their officials extend and improve the local water system through more adequate rate structures on financing is covered in this bulletin available from Thos. F. Wolfe, Managing Director, Cast Iron Pipe Research Association, 3440 Prudential Plaza, Chicago 1, Illinois.

#### A Flat Statement About Round Tanks

434. The title of a new finely illustrated booklet is "Steel Tanks Store Water Best." It gives pictures, essential data, and a fine impression of strength, water-tightness and beauty combined in sturdy structures. For your copy write Steel Plate Fabricators Association, 103 W. Madison St., Chicago 2, Ill., or check our card.

#### Measure Water Accurately In Open Ditches and Channels

694. Parshall Measuring Flumes are widely used by Irrigation Companies, Farmers, Cities and Industries. All steel construction assures accuracy within 2%. Available in sizes for 0.1 to 1340.0 cubic feet per second. Catalog B-31-C contains free-flow discharge tables, sizes, capacities and weights. Thompson Pipe & Steel Co., 3025 Larimer Street, Denver 1, Colorado will send you a free copy for the asking.

#### Mechanical Joint Tapping Sleeve and Valve

344. Smith tapping sleeve and valve answers the problem of making connections, in sizes 2 in. and larger, in water lines under pressure. Check the reply card or write The A. P. Smith Mfg. Co., East Orange, N. J., for full details.

#### Gate Valves

369. A new publication has been issued especially for designers of sewage and waste treatment plants. Write for Circular No. 24 to M & H Valve and Fittings Co., Anniston, Ala., or check the card-number.

#### Are You Using the Right Coagulant?

381. This question, and its answer, are included in new folder that packs much valuable guidance in water and sewage treatment. Read a little and learn a lot. Write to Tennessee Corp., Box 2203, Atlanta 1, Ga., or circle our card-number.

#### Descriptive Folder on the Albite Joint Cast Iron Pipe

410. Contains general description of this Underwriters' approved and patented slip-on joint of the single rubber ring gasket type. Write for your copy to Alabama Pipe Co., Anniston, Ala., or check the number on our card.

#### Water Works Couplings, Clamps and Sleeves

426. Fully described in useful 24-page booklet covering all your pipe needs. Ask for "Water Works Catalog" of Dresser Mfg. Div., Bradford, Pa., or just circle the number on this card.

#### Handbook on How to Lay Concrete Pressure Pipe

524. Manual on concrete pipe laying instructions is available from Price Brothers Co., Dayton, Ohio. Check the reply card for information on how to dig the trench and handle the pipe, make the joint and the pipe bedding procedure.

#### Streamlined and Modernized Fire Hydrants

607. Models, dimensions and advantages of the Eddy fire hydrant are covered in bulletin from the Eddy Valve Co., Waterford, N. Y. Check the reply card for complete details.

#### Data on Portable and Stationary Air Compressors and Accessories

632. Covered in literature available from Gordon Smith & Co., Inc., Bowling Green, Ky., are the basic designs of portable air compressors, models, operating features and specifications. Check the reply card.

#### Turn Your Water Meter Reading Inside-Out

671. The Visi-Meter is a remote recording and indicator system that eliminates the need of entering the home to read water meters. It records within an accuracy of 0.1 percent. Check the reply card or write Visi-Meter, Inc., 301 North 17th St., Kansas City, Kans., for literature.

#### Electronic Locators for Water Mains, Services, Valves and Boxes

677. Miniaturized line locator that is enclosed in a molded glass fibre container and has transistors that have a rated life of 70,000 hours and weighs only four lbs. when completely assembled is described in literature from Wilkinson Products Co., 3047 Chevy Chase Drive, Pasadena 3, Calif. Check the reply card.

## RECREATION

#### How to Equip Your Parks and Playgrounds

414. A handsome 60-page illustrated catalog showing a full line of extra heavy duty playground, park picnic and dressing room equipment, plus many related items, is now available from American Playground Device Co., Anderson, Ind. Complete specifications, construction features, prices and details of labor and materials needed for installation are included. Check the reply card.



### TRACK-MOUNTED MODEL for accuracy and operation ease

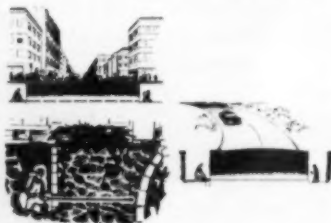
Track-mounted power model has one-man operation; drills laterally up to 14" hole at rate of 5' per minute; drills long range, 200' or more; powered by Briggs & Stratton engine; accurate, portable; Hydrodynamic dirt flush action.

\$430<sup>00</sup>  
3 H.P. f.o.b., Exeter, Nebr.

\$495<sup>00</sup>  
5 3/4 H.P. f.o.b., Exeter, Nebr.

### CUT LABOR COSTS

"MODERN" Earth Auger—either track-mounted or hand-held model, drills under shrubbery, lawns, walks, terraces, streets, railroads, highways without damage to property or disrupting traffic. Water pressure flushes out dirt loosened by the auger; return auger bits will enlarge hole to desired size on return drilling.



### HAND-HELD MODEL for Economical Drilling

Hydrodynamic dirt flush; first job pays for itself, 4" and up dia. return augers; extension shafts 5' length, 3/4" dia. available; use any length pipe.

Complete with 2" pilot auger with 1/2" or 3/4" drive shank. \$49<sup>95</sup>

Contact your wholesaler or write:

**Modern Products, Inc.**  
P.O. Box 344 Exeter, Nebraska





# "MUD'S NO MATTER" to **TYLOX** RUBBER PIPE JOINTS



MUD . . . as shown in the photo, was the prevailing condition on this outfall sewer project in Corpus Christi, Texas. Yet the "mucky" conditions did not slow up installation of the TYLOX-coupled 42" concrete pipe. The line was laid and backfilled as rapidly as the cranes could work, and the joints were *water-tight!*

In specifying TYLOX RUBBER GASKETS, engineers and officials knew they could count on faster pipe coupling to help reduce pipe installation costs, *whatever* the conditions might be. But that's not all . . . in specifying TYLOX they took advantage of a coupling material known also for its ability to make pipe joints leakproof and root-proof for the life of the pipe itself.

#### PROJECT: CORPUS CHRISTI, TEXAS

— Outfall sewer

ENGINEERS: Seigler, Clark & Winston,  
Weslaco, Texas

CONTRACTOR: Burnett Construction Co.,  
Corpus Christi, Texas

PIPE: T & G reinforced concrete, manu-  
factured by TEXCRETE Company, Cor-  
pus Christi, Texas

#### WRITE FOR NEW TYLOX BROCHURE



It contains engineering data and fully illustrated case histories showing why TYLOX Rubber Gaskets are specified the world over to assure the economy, safety and longevity of sewerage and drainage pipe lines.

## HAMILTON KENT MANUFACTURING COMPANY

KENT, OHIO

427 West Grant St.

ORchard 3-9555

3068

To order these helpful booklets check the reply card opposite page 34.

## SEWERAGE AND WASTE TREATMENT

### What You Should Know About

#### Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layouts and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute c/o Editor, Public Works, 208 So. Broad St., Ridgewood, N. J. Check the reply card and we will forward your request.

### How to Make Better

#### Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement-tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass. Check the reply card.

### Automatic Engine

#### Control Equipment Manual

83. This catalog contains descriptions of standard automatic and semi-automatic controls and control equipment. General control recommendations, control selection chart, accessory selection chart, safety stop controls and alarm acts are sections covered. For price lists and models available write Synchro-Start Products, Inc., 8151 N. Ridgeway, Skokie, Ill.

### Theory of Controlled Digestion

#### With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers.

### The Submersible Pump

#### You Have Been Waiting For

141. Electric, fully submersible, portable, runs dry without damage, no priming, and other outstanding advantages. All are described in Flygt Bulletin B-80L of Flygt Corp., Hoesick Falls, N. Y. Address them or just circle the number on our card.

### Elliptical Concrete Pipe

#### for Sewers and Culverts

143. A 4-page bulletin is available from United States Concrete Pipe Co., 1500 Union Commerce Bldg., Cleveland 14, Ohio, on the use of elliptical pipe to obtain round pipe flow equivalents in certain areas. Check the reply card for diagrams, data charts and tables that fully describe elliptical pipe sizes and compute discharge flow rates for the full range of pipe sizes.

### Manual on

#### Sewer Structures

178. This is a 48-page manual on installation design, reference data and graphs showing discharge of pipe based on Manning's formulas. Also such subjects as structural durability, material durability; selection of structures; factors influencing capacity; joints and fittings; and linings for failing sewers are covered. Copies of Manual CMS-7456 are available from the Product Information Service, Armo Drainage & Metal Products, Inc., Middletown, Ohio, or by checking the reply card.

### Rubber Joints for All Types

#### of Concrete Pipe

205. . . . are described and their advantages outlined in a new Engineering Manual which engineers in particular, will find valuable with respect to physical properties and performance characteristics of rubber compounds used in such joints. Plenty of on-the-job illustrations of value to contractors and all pipe-layers. Address Hamilton Kent Mfg. Co., 427 W. Grant St., Kent, Ohio, or check our card-number.

### Foxboro Magnetic

#### Flow Meter

238. The Foxboro magnetic flow meter measures water and wastes electrically, without any line restriction. No loss of head, no fouling, even with slurries. For detailed illustrated Bulletin 20-14B check the reply card or write The Foxboro Co., Foxboro, Mass.

### Select Your Incinerator

#### Scientifically

275. Here is a new swift simple way of selecting the correct industrial, institutional or business-use incinerators for various types of installations. The device is somewhat like a slide rule and takes in the variable factors which determine choices in incinerators. Get yours from Morse Boulger Inc., 80 Fifth Ave., New York 11, N. Y., or check number on our card.

### Packaged Pump Stations

#### for Sewage

306. . . . of advanced design and with six advantages not "packaged" for you elsewhere, are covered in this informative Bulletin No. PS-60R to be had by writing, Tex-Vit Mfg. Co., Box 117, Mineral Wells, Texas.

### Getting Improved Sludge Dewatering

#### With Non-Clogging Vacuum Filters

425. Latest information on the Komline-Sanderson "Coilfilter," which features non-clogging, permanent filter media to obtain constant output and low operating cost is presented in illustrated Bulletin No. 106 by the Komline-Sanderson Engineering Corp., Peapack, N. J. Be sure to investigate this improved method of sludge dewatering. Check the reply card today.

### Be Independent of Power Failures

432. As a first step, ask for catalog of engine-driven generating sets for standby or continuous duty service. Range from 500 watts up through 150 KW in gas or gasoline models to 750 KW diesel category. Address Katolight Corp., Mankato, Minn.



## ● For PUBLIC POOLS ● For PUBLIC WATER SYSTEMS

### ADAMS HIGH-POLISH FILTRATION MEETS EVERY REQUIREMENT

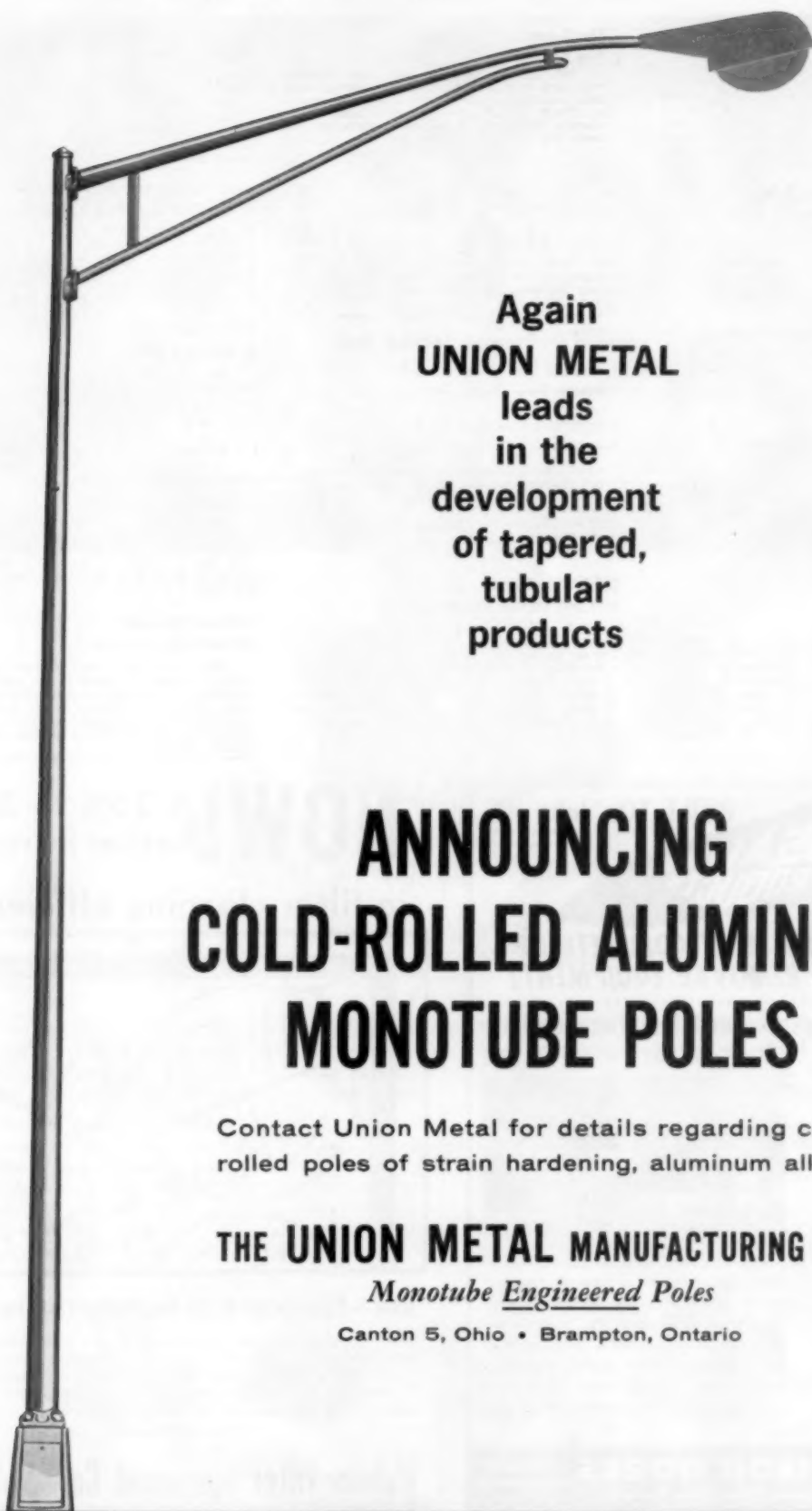
Adams Diatomite Filters start saving you money from the time of installation! They require only a fraction of the space of sand filters, greatly reducing installation costs.

High-polish filtration produces the highest possible clarity, removes many bacteria and reduces your costs for chemical treatment. Longer filter cycles mean minimum operating labor. And Adams' exclusive High-Dome backwash with sloped base and unrestricted backwash opening provides fast, efficient cleaning with minimum water waste. Get full details today. Find out about Adams' quality features such as heavy-duty 100# pressure shell with 3-coat vinyl plastic lining and Adams rugged, permanent Poro-Stone filter elements. Write for Bulletin 626!

### R. P. ADAMS CO., INC.

228 EAST PARK DRIVE • BUFFALO 17, N. Y.

**ADAMS** QUALITY COMES THROUGH



Again  
**UNION METAL**  
leads  
in the  
development  
of tapered,  
tubular  
products

## **ANNOUNCING COLD-ROLLED ALUMINUM MONOTUBE POLES**

Contact Union Metal for details regarding cold-rolled poles of strain hardening, aluminum alloys.

**THE UNION METAL MANUFACTURING CO.**

*Monotube Engineered Poles*

Canton 5, Ohio • Brampton, Ontario

To order these helpful booklets check the reply card opposite page 34.

#### Trenches for Water and Sewer Line Construction

304. Three Cleveland J trenchers incorporating major advances in trencher design and operating advantages are described in Bulletin L-104 available from The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio. Check the reply card for digging capacities, specifications and dimensions.

#### Wedge-Lock "O" Ring Joints for Vitrified Clay Pipe

482. Joints for large diameter pipe, using the Wedge-Lock principle of factory made joints plus a rubber "O" ring for compression sealing, described in 4-page folder of Evans Pipe Co., Uhrichsville, Ohio. Check reply card for your copy.

#### A Solution to Small Engine Problems

490. Descriptive literature covering the 2 to 4½ hp air cooled and 2 to 8 hp diesel YANMAR engines is available from Continental Machinery Corp., P. O. Box 5309, Long Beach 5, Calif. Use the reply card.

#### 27 Diesel and Carbureted Engines Detailed in one Booklet

527. Describes and illustrates all types, from 16.4 to 385 hp., in weights 279 to 6,045 pounds. A brief, handy way to review available industrial engines. To get your copy, write for pamphlet CR-764-K to International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill. or circle the number on our card.

#### Manual on Solving Drainage Problems

645. An 80-page Manual on the problems of drainage and drainage materials is available. Design section includes determining culvert lengths and sizes, run-off calculations, excavation of base and backfilling data. Check the reply card or write Bethlehem Steel Co., Bethlehem, Pa., for the third revision of this valuable book containing new tables for evaluating flow friction.

#### Sewage Treatment Engineering Data Manual

511. This manual contains a brief outline of the various accepted methods of treating sewage and some of the problems, advantages and disadvantages of each. Check the reply card or write Smith & Loveless, Inc., Division—Union Tank Car Co., Lenexa, Kansas for design notes, charts and drawings.

#### Small Unit Sewage Treatment For 20 to 5000 People

568. Bulletin 135A describes the Rated-Aeration process, a low cost, odorless, trouble-free sewage treatment process. Check the reply card or write Chicago Pump Co., 622 Diversey Parkway, Chicago 14 Ill.

#### For Prompt Service Use The Reply Card

#### Reinforced Concrete Pipe For Culverts and Sewers

672. Elliptical Lo-Hed and Hi-Hed pipes, cutout pipe and flat base pipe are described fully in literature from American-Marietta Co., Concrete Products Div., 101 East Ontario St., Chicago 11, Ill. Headwall details, discharge curves, hydraulic capacity tables and hydraulic properties are included. Check the reply card.

#### Clarifier with an Integral Sludge Thickener

717. . . . permits doubling solids concentration without use of a separate tank. The unit is basically a center-feed clarifier with a central thickening compartment at the bottom of the structure where settled sludge is held 12 to 24 hours to attain maximum density. Get Bulletin SM-1918 of descriptive and design data on the Clar-Thickener from the Eimco Corp., P.O. Box 309, Salt Lake City 4, Utah, or check the reply card.

#### REFUSE COLLECTION AND DISPOSAL

##### Where Does It Go From Here?

63. That is the title of new 12-page booklet, D 930, with thorough discussion of garbage disposal by sanitary landfill method. Read the latest report from the experts. Caterpillar Tractor Co., Peoria, Ill., or check card.

##### Load-Packer 600 Points the Way to the Best in Refuse Collection

188. Bulletins W-200, W-220 and W-221 explain how the Gar Wood Load-Packer gives faster operation, bigger payload, more compaction, a larger hopper and more dependable operation. Write Gar Wood Industries, Inc., Wayne, Mich., or check the reply card.

##### How to Construct A Sanitary Fill

331. A new 12-page booklet which tells the most efficient method of sanitary fill construction and furnishes complete information on planning and operation is now available from Drott Mfg. Corp., Milwaukee 15, Wis. Get your copy by checking the reply card: you'll find this booklet both interesting and valuable.

##### Methods and Benefits of Sanitary Landfill

409. Information on Sanitary landfill methods, organization and necessary equipment with which to carry out the job is available from the Construction Machinery Div., Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin MS-1159.

##### Modern Methods in Sanitary Landfills

699. Up-to-date data, pictures and explanation of sanitary landfill, its methods and equipment are covered in this valuable bulletin from The Oliver Corp., 19300 Euclid Ave., Cleveland 17, O. Check the reply card for information on satisfactory garbage and refuse disposal methods.

**BUILT TO "take it"**

**WAUSAU PRODUCTS**

**The WORLD'S MOST COMPLETE LINE of SNOW REMOVAL EQUIPMENT!**

**A Versatile year-round Maintenance Unit TRUCK GRADER — ICE BLADE**

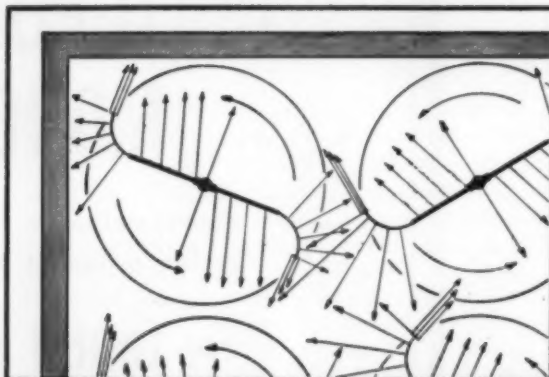
- Wausau Snow Plows - Vee and Blade
- Wausau Snow Wings
- Wausau EXPRESSWAY
- Wausau Sno-Thru Loader and Thrower
- Wausau Material Spreaders
- Write for full details on all Wausau Products . . . Literature available on every item.



Maintains, cuts and grades all types of gravel and dirt roads, eliminates ruts, holes, and washboards. For winter operation it planes, breaks, and removes ice and hard-packed snow hazards . . . truly a versatile year 'round maintenance unit . . . full power hydraulic cab control.

**WAUSAU IRON WORKS** WAUSAU, WISCONSIN  
Pioneer Snow Plow Builders

**NOW!** A 25% to 30% further increase in filter cleaning efficiency



#### New S-Type Filter Arms double the cleaning action

With new S-Type arm of Agitator shown above each corner and void area receives four (4) agitating impulses per revolution instead of two . . . doubling the cleaning action in those areas. S-Type Arms can also be adapted to older units in service. Ask us for full particulars.

(Patent Pending)

**Palmer Filter Equipment Co.**

822 E. 8th St.  
Erie, Penn.





Faces shown in actual size

Easy-Read Model A  
frostproof design  
3/4" through 1" x 1 1/4"

## Bigger face, better features make new Badger *Easy-Read* a standout

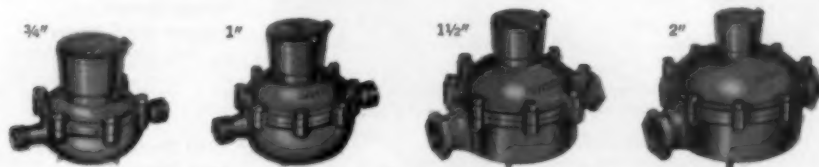
You're looking at the life-size face of the new Badger Easy-Read magnetic drive meter. Its biggest-face-in-the-industry (1/4" high digits) is just one of Easy-Read's exclusives. Here's more:

**SEALED, REMOVABLE REGISTER** — Off comes its head without even disturbing the meter in the line. Easy-Read's register and cover can also be mounted in any of four positions for most convenient reading. Register and gear train parts operate in a clean, dry, lubricated, sealed housing to forever eliminate fogged registers.

**TRULY PERMANENT MAGNETIC COUPLING** — Easy-Read's ceramic magnets are made of high-quality barium alloy material — rustproof, noncorrosive, proven truly permanent. No stuffing box needed.

**INTERCHANGEABLE PARTS** — If yours is a Badger meter system, many parts in the new Easy-Read are interchangeable with the parts in your present meters.

Ask your Badger representative soon for a demonstration of the new Badger Easy-Read magnetic drive meter.



Split-case  
Easy-Read meters  
3/4" through 2"

### Badger Meter Mfg. Company

4545 West Brown Deer Road • Milwaukee 23, Wisconsin

\*Pat. applied for in  
U.S.A. and foreign  
countries

To order these helpful booklets check the reply card opposite page 34.

## STREETS AND HIGHWAYS

### How to Prepare and Maintain Roadways With Calcium Chloride

45. "The Calcium Chloride Road," is the name of a new 24-page two-color catalog issued by the Columbia-Southern Chemical Corp., 632 Port Duquesne Blvd., Pittsburgh 22, Pa. Included are sections on dust control, gradation, placing and mixing materials and shaping. General information on spring, summer and fall maintenance is also provided.

### Why Sod or Plant?

113. . . . when you can establish a grass area in 18 to 21 days merely by rolling it in place. TroyTurf carpets are preseeded and pre-fertilized and can be placed by hand or tractor on level areas or 85° slopes if desired. Write for TroyTurf bulletin, Troy Blanket Mills, 200 Madison Ave., New York 16, N. Y. or circle the reply card.

### Bitumuls Paving Handbook Full of Useful Data

23. The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials, road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, condensed Asphalt Institute specifications plus data on Laykold compounded asphalt for flooring, tennis courts, protective coatings and waterproofing. You can have a copy by checking the reply card. American Bitumuls & Asphalt Co., 120 Market St., San Francisco 20, Calif.

### Chip Dollars from Your Overhead With Fitchburg Chippers

160. Detailed cutaway drawings, specifications, diagrams, charts and money-saving reports and experiences are covered in catalog available from Fitchburg Engineering Corp., Dept. PW, Fitchburg, Mass.

### To Sweep a Better Street for Less

162. Find out about what Prostran can do to make your street sweeper brooms last longer, cut "down-time" and lower your cost per sweeping mile. A folder, with sample polypropylene filament is yours for the asking from E. B. & A. C. Whiting Co., Burlington, Vermont.

### Epoxy Resin Adhesives for Concrete

186. Thiokol LP-3/epoxy resin concrete adhesives are especially suited for use in maintaining or repairing concrete structures. Check the reply card or write Thiokol Chemical Corp., Trenton 7, N. Y., for details on testing and application and working properties.

### Heavy Jobs or Light Jobs—

#### Ford Tractors Will Fit

203. The versatility of Ford tractors and equipment for construction is given new emphasis by the handsome new four-color, 16-page booklet that shows Ford loaders, backhoes, dozers and grading equipment in use with Ford tractors. Heavy and light loading and excavating for a variety of municipal jobs are specially featured. Get Booklet AD-8250 from Tractor and Implement Div., Ford Motor Co., 2500 E. Maple Road, Birmingham, Mich., by checking the inquiry card.

### Illustrated Specifications on

#### Brush and Limb Disposal

222. A new booklet on the modern approach to the brush problem shows how an Asplundh chipper reduces bulky branches and brush trimmings to chip size for mulch or easy removal. Write Asplundh Chipper Company, 501 York Road, Jenkintown, Pa., or use the handy reply card.

### Paints For Bridges, Water

#### Tanks & Other Metal Structures

258. Flake silica graphite paints for outdoor metals are described fully in literature from Paint Sales Div., Joseph Dixon Crucible Co., Jersey City 3, N. J. Check the reply card for details on these primer and protective paints.

### Stumped by Stumps?

303. Pow-R-Stump cutter is operated by one man, handles stumps of any width and up to 33 ins. in height and will not damage curbs, driveways or sidewalks. For literature check the reply card or write Vermeer Mfg. Co., Pella, Ia.

### Don't Dig—Auger

328. Modern earth augers and their applications in installations under lawns, streets, highways, walks, buildings, etc. are discussed in this bulletin, A1-10M-2-60. Write to Modern Products, Inc., Exeter, Nebraska.

### Manual on Steel and

#### Wire for Road Building

337. Design data on wire fabric for concrete pavements, joint data, cable highway guard, wire fabric, steel and wire for concrete pipe and reinforced bituminous concrete design are some of the sections covered. Check the reply card or write American Steel & Wire Div. of United States Steel Corp., Cleveland 13, Ohio, for this valuable manual.

### Fertilizer Distributor

#### for Parks and Roadsides

362. Uniform spreading, even on rough ground, and simplified maintenance that assures long, economical use are features of the Lely fertilizer distributor. Colorful brochure giving full details is available from Lely Ltd., P. O. Box 235, Burlington, Ontario.

### Prompt Service on

#### Sweeper Refill Fibers

367. Here's a dependable source of power sweeper refill fibers, including domestic and imported types and gutter broom wire. To get all the data write A. Steiert & Son, Inc., Hatfield, Pa., or use our reply card.

### 1961 Truck Line Story

#### From Chevrolet

446. The 1961 Chevrolet truck line is described fully in literature from Chevrolet Motor Division, General Motors Corp., General Motors Building, Detroit 2, Michigan. Check the reply card for data on this line of 165 models.

## NEW MINIATURIZED WILKINSON LINE LOCATOR

Radically new, powerful, transistorized locating instrument weighs only 4 lbs. and is 1/4 as large as old type pipe locators.

Telescoping aluminum handle; 2 oz. single ear set; all in carrying case.

Write today for brochure and instruction manual.



WILKINSON PRODUCTS COMPANY Since 1940

3987 Chevy Chase Dr., Pasadena 3, Calif.

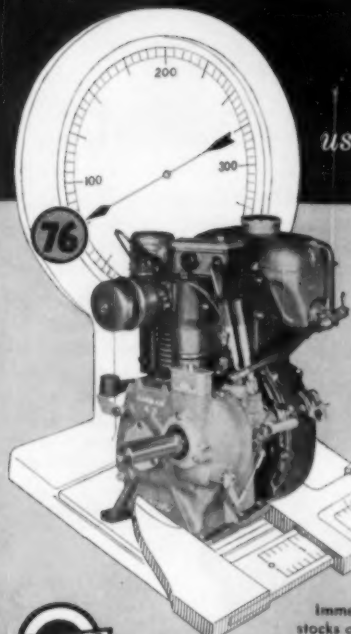
SYlan 0-4314

## Where's your small engine PROBLEM?

WEIGHT? SAFETY?  
SIZE? ECONOMY?

use **YANMAR**  
DIESEL POWER

AIR COOLED MODELS—  
2 TO 4 1/2 BHP  
WATER COOLED MODELS—  
2 TO 8 BHP



Easy starting—  
Smooth running.  
Big engine features  
in a compact package!

—a precision product of the new Japan  
made to U.S. specifications by the world's  
largest manufacturer of small diesel engines.

Immediate delivery from large U.S.  
stocks of engines, accessories and parts.

for literature and dealer information, write

**CONTINENTAL MACHINERY CORP.**

19402 So. Susana Rd., Compton, Calif. Mailing Address: P. O. B. 5309, Long Beach 5, Calif.





Butler buildings at Charcoal City • Storage Building • Transfer Shed • Power House • Tractor Garage (2) • Processing and Packaging • Pump House • Unloading • Equipment Repair • Office • Elec. Sub-Station • Head Houses (2) • Conveyor Shelter



## "CHARCOAL CITY"...

### a village of **Butler Buildings**

The folks around Parsons, West Virginia, have come to think of the Kingsford Chemical Company's plant as Charcoal City. Here, nestled in the hills of West Virginia, is a large, completely self-contained manufacturing facility for producing charcoal briquettes.

And every structure in Charcoal City, from the office to the pump house—including processing and warehousing facilities—is a pre-engineered Butler building.

Why Butler? The answer is simple. First of all, with Butler you're not limited to a few standard size buildings. You can choose from a wide selection of pre-engineered components and build as large or as small as you wish. Then, there's Butler quality. Precision fabricated

Butler components fit together perfectly. Your completed building is neat, structurally sound, and completely weathertight. Interiors are spacious, free of columns and overhead trusses. Your Butler building gives you more usable space for your construction dollar. And, of course, there are the inherent advantages of all-metal construction: standardization, fire safety, favorable insurance rates, low maintenance costs, and fast, economical expansion.

If you're planning to expand existing facilities, or build a completely new plant, get the full story on Butler buildings today. Call your nearby Butler Builder. Ask about Butler financing, too. He's listed in the Yellow Pages under "Buildings" or "Steel Buildings." Or write direct.



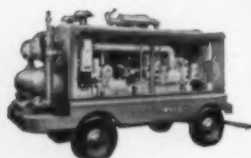
**BUTLER MANUFACTURING COMPANY** 7321 East 13th Street, Kansas City 26, Missouri

Manufacturers of Metal Buildings • Plastic Panels • Equipment for Farming, Transportation, Bulk Storage, Outdoor Advertising • Contract Manufacturing. Sales offices in Los Angeles and Richmond, Calif. • Houston, Tex. • Birmingham, Ala. • Kansas City, Mo. • Minneapolis, Minn. • Chicago, Ill. • Detroit, Mich. • Cleveland, Ohio • New York City and Syracuse, N.Y. • Washington, D.C. • Burlington, Ontario, Canada



Trenching 7 miles of street, this Jaeger "125" Roto ran two 80 lb. breakers to line-cut and break a 7" top of asphalt over brick — averaged 1200 sq. ft. per 8 hr. day—used only 1½ gals. of fuel per hr.

## Jaeger "125" Rotary speeds street work



2-wheel: 75, 85, 125, 250 cfm  
4-wheel: 365, 600, 900 cfm

Instantaneous air delivery, under close and smoothly modulated control, enables the Roto 125 to maintain 100 lbs. minimum pressure under all demands up to 125 cfm. High efficiency results in slower speed operation, less fuel consumption, longer engine life than any other rotary. See your Jaeger distributor or ask for Catalog

**THE JAEGER MACHINE COMPANY 400 Dublin Ave., Columbus 16, Ohio**

PUMPS • MIXERS • TRUCK MIXERS • PAVING MACHINES

## NEW CATALOG!



No. 163

ESTABLISHED 1908  
**W. S. DARLEY & CO.**

WRITE TODAY

For

100 PAGE

MUNICIPAL CATALOG

**W. S. DARLEY & CO.**

CHICAGO 12



## AMERICAN Approved PLAYGROUND AND SWIMMING POOL EQUIPMENT

The wise choice of experienced buyers for nearly half a century.

WRITE FOR LITERATURE



## The Trucks You Need for Every Public Works Job

441. Extra life and operating economies are built-in features of every Ford truck model. There's a chassis size and engine for each of your needs, from light utility work to heavy-duty construction jobs. Get latest literature from Ford Motor Co., Truck Div., Dearborn, Mich., by checking the reply card.

## Versatile Trenchers Mount

### On Jeeps or Tractors

304. "Gear-Draulic" boom-type trenching attachments by Auburn mount on tractor or Jeep, give new utility to your equipment. Get descriptive brochures from Auburn Machine Works, Inc., Auburn, Nebraska. Use the inquiry card.

## Remember When You Hoed Weeds?

516. Not any more! For full data on how chemical weedkillers for roadsides make a clean sweep of obnoxious weeds get booklet on AMIZOL, from Amchem Products, Inc., Ambler, Pa. Circle their number on our card.

## For Soil Sampling and Pavement Coring

576. There's an easier way to do both with Acker equipment. Bulletin 26-R describes a kit containing 12 different soil sampling tools. Bulletin 40-R tells about the All-Purpose auger for all types of sub-surface exploration. Bulletin 700-R illustrates the Acker Shear Test Kit for in-place shear tests in soft areas. Name the ones you want. Acker Drill Company, Inc., Box 830, Scranton, Pa., or check our card.

## Complete Line of Asphalt Patching Mixers

396. Mixers capable of mixing 3 to 20 tons of hot mix per hour are described in literature available from McConaughay Mixers, Inc., Lafayette, Ind. Check the reply card for full information on patching, repairing, resurfacing and sealing.

## Vacuum Cleaner and Leaf Collector For Cleaner Streets

595. A unit is now available that can be mounted on a right-hand drive jeep or a pick-up truck for picking up gutter trash and leaves. Complete specifications, capacity, operation and installation procedures are covered in a bulletin available from Tarrant Mfg. Co., Saratoga Springs, N. Y.

## Information on Trucks for Every Job

632. Literature on the complete International truck line is available from International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill. Included is information on basic models, conventional and COE, 4-wheel, 6-wheel and four-wheel-drive. Check the reply card.

## SNOW AND ICE CONTROL

### Uniform Salt Spreading Saves Material

42. The wide, thin pattern provided by Tarco "Scotchman" spreaders avoids salt waste, saves time and labor. Get Folder BL for full details on their spreader and table of material application rates. Use reply card or write Tarrant Mfg. Co., Dept. PW, Saratoga Springs, N. Y.

### Complete Ice and Snow Fighting Equipment

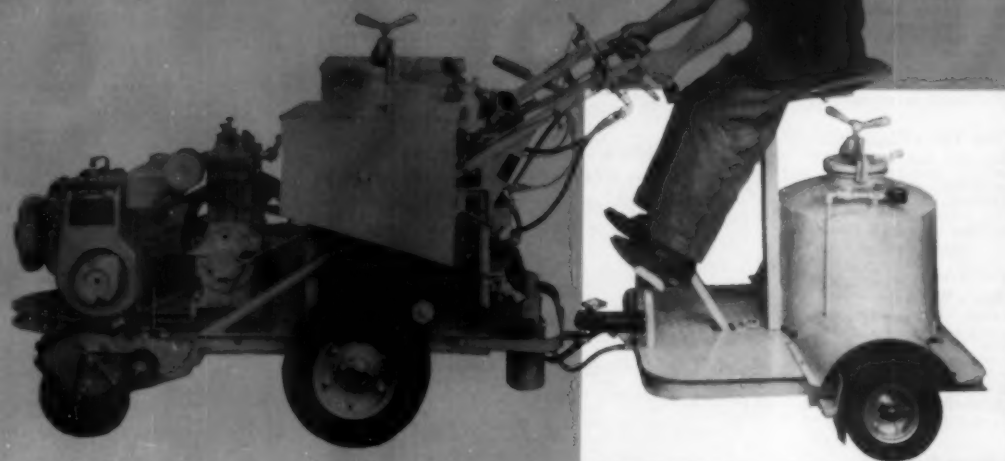
523. Snow plows in 55 models and 9 types, material spreaders with width of spread of 8 to 20 ft. and hopper capacity of 2 cu. ft., and truck grader ice blades are covered in literature from Wausau Iron Works, Wausau, Wis.

### Salt, Sand and Cinder Spreaders

532. . . . are fully discussed in folder No. A-450 outlining how these are dump body mounted for quick attachment and detachment according to service and season. Basic specifications outlined. Just address Baughman Mfg. Co., Jerseyville, Ill. or use the reply card.



*Now... a 2-color portable striper*



## The Wald Tandem Tanker does it!

The new Wald Tandem Tanker quickly converts a standard Wald Model 16 Reflecto-Liner into a two-color machine, or doubles its paint capacity for a two-gun single color operation. Inexpensive, but invaluable in helping you conform to new Federal two-color marking standards, this accessory, with the Wald Model 16 is an unbeatable combination for economy and efficiency where the volume of striping does not require a truck-mounted machine. It may also be used with a Wald Model 12 to stretch the striping time without refilling.

*Update your equipment in time  
for this year's striping season.*

Wire or phone today for information and prices.

**WALD**  
**TANDEM TANKER**

PUBLIC WORKS for March, 1961

### The Wald Tandem Tanker gives you these benefits:

- Doubles paint capacity (30 gallons)
- Two-color operation conforming to new Federal standards (with Wald Model 16)
- Operate from sitting or standing position
- Perfect balance for easy steering
- Positive braking action
- Adjustable wheels to prevent tracking
- Detachable for optional use

*For new developments the world looks to Wald, Inc.  
the leader in highway marking machines.*

**WALD INDUSTRIES, INC.**  
HUNTINGDON, PENNSYLVANIA

To order these helpful booklets check the reply card opposite page 34.

## CONSTRUCTION EQUIPMENT AND MATERIALS

### Make Your Utility Tractors Still More Versatile

43. How to use them to full advantage, what matched equipment can be had to enlarge tractor operations and keep costs down by keeping your tractors busier is described in new Catalog UT-111. For your copy write Allis-Chalmers Mfg. Co., Tractor Group, Milwaukee, Wis.

### Don't Stand There Figuring!

51. Use the new Forney PSI Calculator "slide rule" for concrete products that includes instant conversion data from total load to psi on 17 standard test specimens and masonry units. Pocket size. Free. Address Forney's Inc., Tester Div., Box 310, New Castle, Pa.

### Don't Send a Man to do a Boy's Work

108. Look into the SJ Maintenance distributor designed specifically for paving jobs where using bigger equipment would be impractical and uneconomical. Yet the SJ can be diverted to projects as big as construction of secondary roads. Why not find out about it by writing Standard Steel Works, North Kansas City, Mo., or just circle number on the card.

### Booklet Shows Design of Pre-Engineered Steel Buildings

271. Pre-engineered Butler steel buildings are available in every size, type and design to meet your building needs. In a helpful four color booklet you will find details on several basic designs for community use; answers to your questions on construction and erection; and many illustrations of typical uses. Write to Butler Mfg. Co. 7321 East 13th St., Kansas City, Mo.

### International Wagner Heavy-Duty Loaders and Backhoes

195. International Wagner loaders and backhoes are matched with International utility tractors and are described in Catalog CR-1369-K available from International Harvester Co., Consumer Relations Dept., 180 N. Michigan Ave., Chicago 1, Ill. Check the reply card.

### The Principles of Compaction by Vibration

288. Compaction specifications that can't be met with ordinary compactors are no problem to the new Eslick vibrating rollers. Complete descriptive literature explaining the principles of compaction by vibration and the Eslick vibrating roller is available from Eslick Mfg. Co., 1950 Santa Fe Ave., Los Angeles, Calif.

### Added Loader Attachments Add More Mileage for Your Tax Dollar

383. . . . are the intriguing title and content of this handy 16-page pocket-size booklet listing new equipment and new uses for the PAYLOADER you have or the one you are going to get. Ask for "More Mileage" from the Frank G. Hough Co., Libertyville, Ill.

### Tractors and Equipment for Municipal Use

407. Specification sheets for the John Deere crawler and utility wheel tractors; also equipment for loading, dozing, mowing, sweeping and many other operations. John Deere, Industrial Division, Moline, Ill. Check the reply card, State type of tractor and equipment.

### Manual on Construction Castings

462. This 168-page Manual covers catch basin inlets and traps, building castings, man-hole covers and steps, flap valves, wheel guards, drainage grates and many other construction and maintenance castings. Check the reply card or write Neenah Foundry Co., Neenah, Wis., for your copy.

### What Henry Didn't Know About Tractors and What It Cost Him

513. This is the theme of a "comic book" that has as much sound information and sense in it as it has laughs. And there are plenty of both. Moral: Ignorance is not bliss when it is costing the tractor owner money. Your men will appreciate it. For copies, write for "Henry's Crawler," to Advertising Dept., J. I. Case Co., Racine, Wis. or circle our reply card.

### The Tractor that Comes Nearest to Doing Everything!

529. Among other unique features it lets you drive with toe-operated Hydro-Shuttle, change speed or direction instantly. High torque at low rpm means no stalling under heaviest loads. Many other advantages described in MoTrac booklet. Get your copy from Minneapolis Moline, Hopkins, Minn., or ring the number on card.

### Latest Crawler Tractor

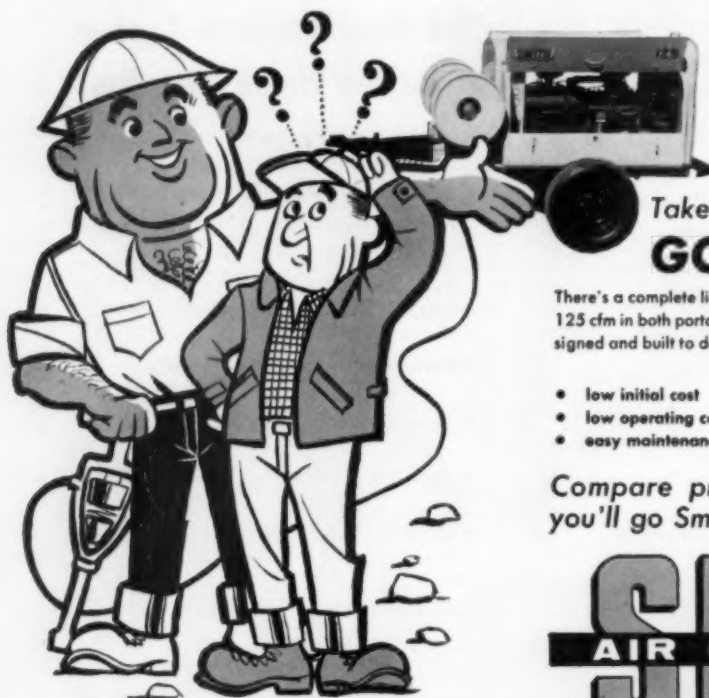
530. . . . in the 6,000-pound class; gas or diesel, with special features to assure alignment of tractor components and mounted equipment; rugged track assembly, "live" hydraulic systems, and shuttle clutch as standard equipment. For the full story, address Allis-Chalmers Mfg. Co., Utility Crawlers, Milwaukee 1, Wisc., or circle number on the card.

### Big Tractor-Powered Equipment

540. Including tractor shovels, dozers, scrapers, loggers and special equipment models and features illustrated and described in attractive brochure available from Clark Equipment Co., Construction Machinery Div., Benton Harbor, Mich. Or just check number on our card for us to order for you.

### Attachments For Ford Tractors

643. Clearing, backfilling, ditching, excavating, mowing, scarifying, sweeping, and trenching equipment are a few of the attachments described in literature from Tractor and Implement Div., Ford Motor Co., 2500 East Maple Road, Birmingham, Mich.



## ALL "SHOOK UP" DECIDING ON AN AIR COMPRESSOR?

Take "Hardrock Smitty's" advice and  
**GO SMITH!**

There's a complete line of Smith compressors ranging in size from 45 cfm to 125 cfm in both portable and stationary models. The Smith compressor is designed and built to deliver years of trouble free service under all conditions.

- low initial cost
- low operating cost
- easy maintenance
- simple, compact design
- quick starting
- single stage compression

Compare price . . . compare job results  
you'll go Smith!

# SMITH AIR COMPRESSORS SMITH

GORDON SMITH & COMPANY, INC., Bowling Green, Ky.

Ask your dealer for an "on the job" demonstration. (write us for complete information and the name of your nearest dealer)



While torque-converter drive is of primary benefit in front-end loader operation, it also gives you the extra power and traction you need for getting your backhoe in and out of muddy conditions like this.

**Other important benefits you get as standard equipment with the CASE W-3**

- Choice of Case-built 52 hp gasoline or Diesel engine
- Bigger drive tires — 14.9 x 24 6-ply
- 10-ply front tires
- 7000-lb capacity front axle
- Full power steering
- Shuttle transmission
- Backhoe digs 14 ft deep. Swings 180° with exclusive foot control
- 2500-lb lift capacity front end loader with 6000-lb breakout force. 15 cu ft to 1 cu yd bucket
- Self-leveling bucket
- Wide choice of interchangeable attachments including: dozer, grade-blade, pallet-fork, crane-hook, choice of four loader buckets and eight backhoe buckets

## Why your next backhoe-loader should have both torque converter and direct drive

Many users of wheel-type backhoe-loaders make the mistake of buying the *lowest priced* rig available — only to discover that it *doesn't* have enough power or traction to handle many of the jobs expected of it. For this reason, you will be money ahead by choosing a higher-output machine, like the Case W-3, that combines the power-boosting benefits of a torque converter, with the speed and economy of direct drive. Here's why!

### Travels and works where others can't

Since a torque-converter-equipped tractor provides an *infinite* number of speed ratios — down to 0 mph without stalling — you get a *lot more traction*, with *minimum wheel slippage*. Result: With the Case W-3, you can load faster, backfill, climb slippery grades, travel and work through hub-deep mud that would stall ordinary wheel rigs.

### Double push-pull power—without clutching or shifting

The diesel or gas-powered Case W-3, with torque converter, gives you *twice* as much push-pull power as the same size conventional rig. In addition, torque output is matched to the load instantly—**AUTOMATICALLY**—*without clutching, shifting, or stalling*. This enables you to load-out bigger payloads much faster with the front-end loader... a tremendous time-saver in backfilling, and clean-up operations... an extra money-maker in truck-loading.

### Full hydraulic priority... longer life

The converter keeps engine and hydraulic pump running at full effective rpm, without "lugging down". You *always* have full hydraulic power for fast break-out with the loader bucket. The torque converter also gives you longer tractor life since all components are protected against operating shocks by a "cushion" of hydraulic oil.

### Drives job-to-job at 19.3 mph

With the Case W-3 loader, or combination backhoe-loader, you get all these proven benefits of torque-converter drive — *plus* a handy lock-out lever that lets you *switch* to direct drive "on-the-go" — for 19.3 mph road travel.

### Nets you more profit per dollar of investment

While the Case W-3 costs a few dollars a month more than so-called "economy" diggers, its extra productivity and go-anywhere ability, enable you to handle a *wider range* of backhoe-loader jobs at *higher net profit*. See your Case Industrial Dealer for convincing proof, or write J. I. Case Co., Dept. C 1341, Racine, Wis.

**CASE.**  
J. I. CASE CO., RACINE, WIS.

**ONLY THE CASE W-3 GIVES YOU BOTH... SEE AND COMPARE IT TODAY!**



To order these helpful booklets check the reply card opposite page 34.

#### Catalog on Utility Bodies and Equipment

698. General Service Bodies; Maintenance Bodies; Line Construction Bodies; Mechanical and Hydraulic Aerial Ladders; SKY-MAN-TERS (Aerial Devices); Winches; Hydraulic Derricks; Pole Trailers; Hydraulic Cable Reel Trailers; and Related Accessory Items of Equipment. Write McCabe-Powers Body Co., 5900 N. Broadway, St. Louis 15, Mo.

#### Versatile Crawler With Power and Controllability

707. Within this 24 page booklet (Form No. 607R) are liberally illustrated descriptions of the features of the Euclid C-6 for clearing, dozing, stripping, grading and a variety of other applications. Specifications covered. Circle reply card or write to Euclid Division of General Motors Corporation, Cleveland 17, Ohio.

#### 100 HP Motor Grader

715. Model 330-II features a constant-mesh transmission, 8 forward and 4 reverse speeds, full-diesel rubber-mounted engine. With hydraulic brakes, ample strength and weight, and a wide range of blade adjustments. Write for bulletin (Form No. M6-174) from Le-Tourneau-Westinghouse Company, Peoria, Illinois, or circle reply card.

### STREET LIGHTING AND TRAFFIC CONTROL

#### Steel and Aluminum Lighting Poles for Streets and Highways

74. Standard designs, assembly details, suggested pole sizes and base construction details are some of the information offered in Bulletin LS-29 (Steel) and Bulletin LS-30 (Aluminum). Check the reply card or write The Union Metal Mfg. Co., 1432 Maple Ave., N.E., Canton 5, Ohio, for details covering the latest Monotube pole designs for modern streets and highways.

#### Finest Line of Markers for Fine Line Marking

165. Complete information on truck mounted highway markers, self-propelled line markers, all purpose line markers, and hand-propelled line markers is available from the M-B Corporation, New Holstein, Wis. Photographs and specifications of each type of line marker are included. For more, check the handy reply card.

#### Lighting Standards for Every Outdoor Lighting Requirement

284. Complete design details, typical installation photos and how Stress-Spun standards are made are covered in this valuable guide. Check the reply card or write to the American Concrete Corp., 5092 North Kimberly Ave., Chicago 30, Ill., for Catalog 400.

#### Complete Line of Traffic Signals and Control Equipment

389. A full line of traffic signal and control equipment is covered in the comprehensive catalog of Econolite Corp., 8900 Bellanca Ave., Los Angeles 45, Calif. Wide choice of components offers economy and flexibility to suit future requirements. For more information write direct to Econolite or use the convenient inquiry card.

#### Literature on Reflective Glass Beads

571. Glass beads for traffic signs and street name signs as well as sign bead dispenser equipment are described in literature available from Flex-O-Lite Mfg. Corp., 8301 Flex-O-Lite Drive, P. O. Box 3066 (Afton Br.) St. Louis 23, Mo. No. 831 high index of refraction glass beads for white and yellow backgrounds and UB 68 medium index of refraction glass beads for reflectorizing dark colors such as red, green, blue, etc.

#### Put Traffic Signals Out Where They Can Be Seen

606. A 20-page booklet points out how to do this most effectively, gives fullest detail. Follow it and more motorists will love you. As first step, ask for Catalog TE-1 of Pfaff & Kendall, 84 Foundry St., Newark 5, N. J., or circle number on our card.

#### Complete Catalog on Traffic Control Equipment

240. All types of controllers, PR system of coordinated traffic control, vehicle detectors, timers, vehicle counters and radar speed meters are covered in catalog available from Automatic Signal Div., Eastern Industries Inc., Norwalk, Conn. Check the reply card.

#### Let Progress Hit Your Highway Signs, too

575. An overlaid plywood especially engineered for highway sign construction is now available in natural surface for reflective overlays, also in green, white, red and blue. AASHO approved. Resistance to damage cuts maintenance costs. For GPX description and specifications write Georgia-Pacific Corporation, Equitable Bldg., Portland 4, Oregon, or circle number on our card.

### BUSINESS ADMINISTRATION

#### Monthly Time and Cost Record Book

249. To assist owners in determining the cost of owning and operating equipment Caterpillar Tractor Co., News Service, Peoria, Ill., has prepared a 24-page monthly time and cost record book. Twelve sets of pages are included on which to record day by day machine expenses for an entire year. Check the reply card for your copy.

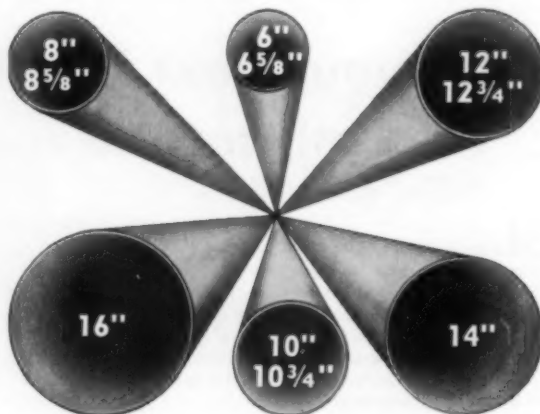
#### Complete Bulletin On Municipal Supplies

473. Everything from leak locators to street signs is listed in the big 100 page bulletin "Municipal Supplies" published by Darley. Hundreds of different items for all city departments are included. Get your copy of Bulletin No. 163 from W. S. Darley & Co., 2814 Washington Blvd., Chicago 12, Ill.



Synchro-Start's new protective engine controls have been designed, for the starting and stopping of engines from remote pilot devices, such as pressure switches, float switches, power failure relays, etc., and are completely automatic in operation. These dependable controls are encased in a steel, dust proof cabinet, and now feature enclosed PLUG-IN RELAYS as well as OVERLOAD BREAKERS. The plug-in relays simplify what little field maintenance that may have been required in older models, while the overload breakers eliminate the necessity of replacing fuses. In designing this unit we have used the same high quality materials and workmanship that our customers have come to expect throughout Synchro-Start's 27 years of manufacturing engine controls.

**SYNCHRO-START PRODUCTS, INC.**  
8151 N. RIDGEWAY AVE. • SKOKIE, ILLINOIS



### NEW high frequency, resistance welded pipe

If you want a closer source for pipe that meets the highest standards of the industry, better talk to Valley. New resistance welding and process control facilities assure you of the quality you demand. Ideal as line pipe for gas, water, air conditioning ducts, etc. Special wrappings and coatings. Steel piling also available.

Sizes: 6" 6 5/8" 8" 8 5/8" 10" 10 3/4" 12" 12 3/4" 14" 16" in wall thicknesses to .219.

Write or call Steel Pipe Division

**VALLEY** MANUFACTURING COMPANY  
VALLEY, NEBRASKA



# It's Here ... The First COMPACT IN PUMPING

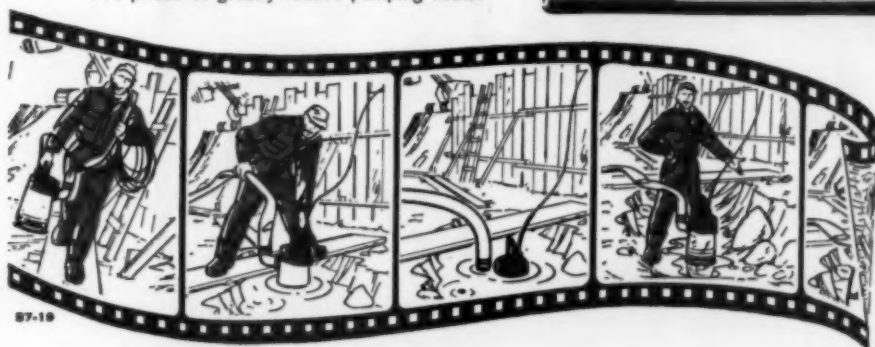
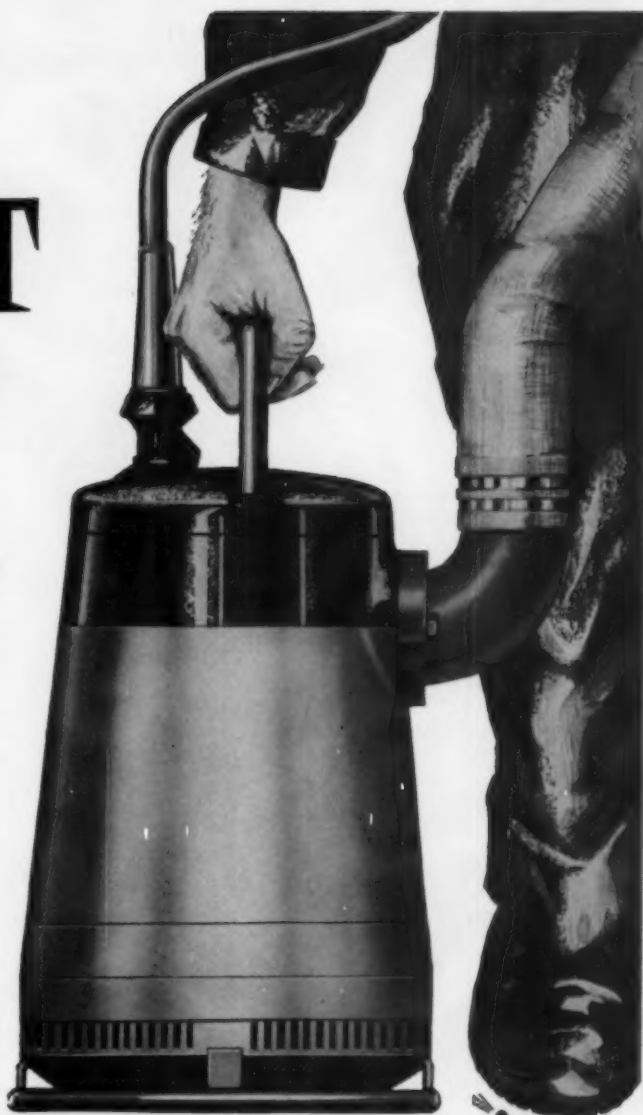
**FLY**

**Bibo 3"**

**ELECTRIC SUBMERSIBLE**

**CHECK THE FACTS . . . !!!**

You can't discount experience, satisfied users or mounting sales. The world's first submersible "dirty water" pump was designed by "Flygt" in 1946. Ever since, thousands of customers the world over are relying on economical "Flygt" performance. Recently competition has followed the lead established by "Flygt", confirming the superiority of in-the-water pumps. Advanced research, imaginative engineering and manufacturing know-how plus 15 years of field testing result in "Flygt" quality. There's a "Flygt" for every job - 1½" to 8". **NOW** the **NEW Bibo 3"** COMPACT, weighing only 88 lbs., delivers 20,000 GPH. Only "Flygt" could offer you a pump like the Bibo 3". Do yourself a favor, see it in action on your next job. One more important point . . . priced to greatly reduce pumping costs.



Available in 220-440V.  
and 550V.  
also 220V single phase

**FLY**

*Corporation*

ORIGINAL MANUFACTURERS OF ELECTRIC  
SUBMERSIBLE 'DIRTY WATER' PUMPS!

HOOSICK FALLS, N. Y.

WESTERN SALES & SERVICE: STANCO MFGS. & SALES INC., 1666 Ninth St. (Corner of Olympic) Santa Monica, Calif. • IN CANADA: FLYGT CANADA LIMITED, Montreal, P. Q.

**PUMP BETTER ELECTRICALLY, USE FLYGT!**



*City of Binghamton sees clear water ahead for a full generation*

## Westinghouse Powers-Up New Filtration Plant to Meet Rising Demands of Next 30 Years

Present population: 85,000—growth reaching at least 105,000 by 1975. This is the future for Binghamton, booming city in upstate New York. With this fact in mind, planning of their new 4,000,000-dollar filtration plant accented expandability for rapidly increasing water demands to 1990.

Westinghouse has provided a power distribution system that will assure this objective. With present pumps and treating equipment, total capacity is 31,000,000 gallons per day. Plant capacity can be expanded 50% during the 30-year period without additional substation, bus or switchgear equipment. Beyond basic flexibility, the electrical equipment will be called upon for absolute, 24-hour reliability for this projected long life span. Westinghouse power components are coordinated to work together, and will fulfill this objective also . . . dependability, with minimum servicing or maintenance.

For look-ahead electrical planning and products to match, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

*You can be sure . . . if it's Westinghouse.*

Westinghouse



J-94152-2

1. The Susquehanna gives up its water . . . Pipe gallery located under the filter operating floor houses raw water, backwash and waste water lines, control piping and valves.

2. Strength, beauty and simple utility . . . Plant exterior is finished in blue glazed brick, yellow porcelain enameled steel panels, anodized aluminum trim.

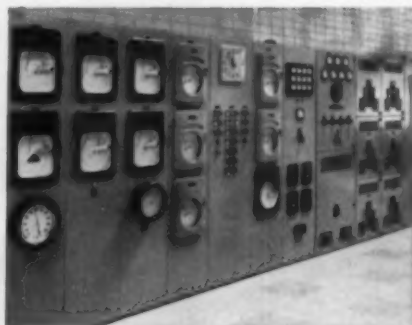
3. Utilized plant control . . . Main distribution center for new plant provides power to motor and auxiliary feeder circuits. Fed by 4000-ampere ventilated low-impedance bus duct, board consists of (right to left) plant service transformer and power panels; 480-volt switchboard with incoming line and motor feeder breakers of reliable DB design; control panels including flow and pressure indicators, gauges and master indicating lights to show status of all plant operating equipment. Entire unit was assembled by Westinghouse and delivered complete and prewired for fast, easy installation.

4. Mr. G. E. Rickard, Water Superintendent, checks ammeter reading at incoming switchgear and master control board with Mr. R. C. McNamara, City Engineer, who supervised over-all construction project.

5. Dependable power for 30 years . . . G. E. Rickard and R. D. Batley, Westinghouse Sales Engineer, discuss one of three Westinghouse SL transformers in plant outdoor substation. Present bank capacity is 2500 kva—future up-rating to 2875 kva is possible through provisions for addition of forced air cooling. Westinghouse transformers feature exclusive Insuldur® insulation and Hipersil® grain-oriented steel cores to give extended life and higher efficiency. This substation, furnished by Westinghouse, also includes: 15-kv, 600-ampere, 100,000-kva IC oil circuit breakers; Type V disconnect switches; Type S station service transformer; main low-voltage bus as well as the integrated steel structure.



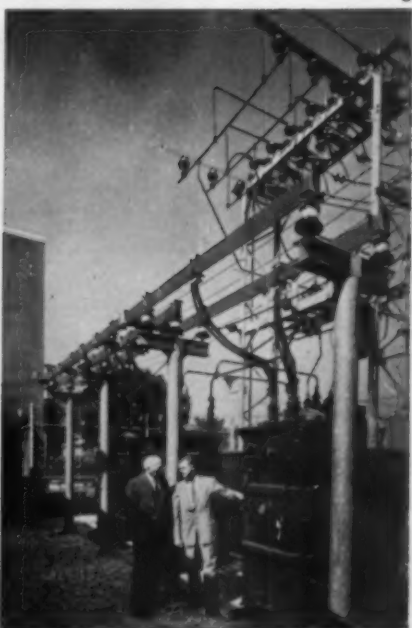
2



3



4



5



6



7



8



9



10



## Filtration Plant Powers-Up for Next 30 Years

(cont'd)

OWNER: *City of Binghamton*

GENERAL CONTRACTOR: *Smith-Howard and Sprague, Binghamton, N. Y.*

ELECTRICAL CONTRACTOR: *Lord Electric Co., Inc., New York, N. Y.*

CONSULTING ENGINEERS: *Leonard S. Wegman Co., New York, N. Y.*  
*Alexander Potter Associates, New York, N. Y.*

ELECTRICAL DISTRIBUTOR: *Westinghouse Electric Supply Co., Long Island City, N. Y.*

6. Compact, expandable motor control . . . These Westinghouse units, together with the lighting panel-board (door open), centralize control for all auxiliary equipment in the chemical building. Motor starters serve mixers, drives, pumps. Thirty-kva transformer, feeding panelboard, completes assembly. Blank sections, at left, permit future additions.

7. Control for added capacity . . . Starters for high lift pumps include two new Westinghouse reduced voltage autotransformer types to complement several starters moved from original plant. Control accessories were added to modernize these—thus providing an economical conversion to the new control scheme. Westinghouse starters were used to control new 600-hp high lift pump and 125-hp wash water pump.

8. Close cooperation among the consulting engineer, electrical contractor and Westinghouse makes it possible for Binghamton to provide for the future today. Seen at left: A. J. Juris and E. J. Young of Lord Electric Co.; E. Piller, Westinghouse Electric Supply Co.; P. J. Gallagher, Westinghouse; and J. J. Fenley of Lord.

9. Color and light welcome visitors . . . Lobby area is handsome with terrazzo flooring, marble paneling, mosaic tile stair wells. Westinghouse Mainliner fluorescent luminaries blend with building's structural elements. Average illumination intensity is 90 foot-candles.

10. Room for more . . . C. E. Ahern, filter operator, seen at Westinghouse NLAB lighting panelboard which contains normal and emergency breaker sections with spares for future circuits. Flush trim and special brass hinges harmonize with architectural detail of plant.

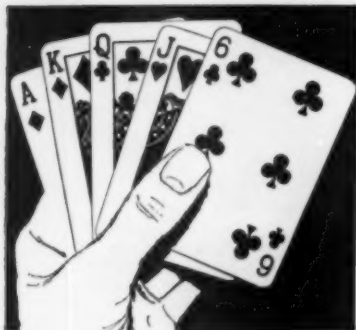
11. Take water, add chemicals, mix well . . . G. E. Rickard and R. D. Batley inspect the slow mix tanks. Settling tanks in background provide 3½-hour detention. Entire area is illuminated at night to promote safe operation and permit 24-hour observation of flocculation process.

J-94152-4

Westinghouse



## POKER? Play to win!



### How would you play this hand?

Don't let the high cards tempt you. This is no better than drawing to an inside straight (odds about 12 to 1 against filling). Fold...fast...and patiently wait for a good hand.

### Here's a sure winner from FORD:

Ford pays half your fuel bills for a full six months (or 400 tractor hours) on the purchase of any new Ford or Fordson diesel tractor.

This offer, made possible by the amazing fuel-saving performance of these low-priced diesel tractors, expires March 31, 1961.

No "hidden" price increase... no tricks of any kind. See your Ford Tractor Dealer for all the money-saving details!

**Tractor and Implement Division,  
Ford Motor Company,  
Birmingham, Michigan**



## LEGAL ASPECTS OF PUBLIC WORKS

MELVIN NORD, Dr. Eng. Sci., LL.B.

### Notice of Claim to City

*Brandner v. City of Aberdeen*, 105 N.W. 2d 665, a South Dakota case decided Nov. 2, 1960, was an action against the city for injuries sustained by the plaintiff in a fall on an icy sidewalk. The plaintiff alleged that the City and the owner of the abutting property were negligent in permitting snow and ice to accumulate on the sidewalk, thus creating a dangerous condition which caused injury to the plaintiff.

The City defended on the basis that the plaintiff had not complied with the usual statutory provision requiring notice to the City of the time, place, and cause of the injury within sixty days of the injury.

Plaintiff's rebuttal to this argument was to the effect that as a result of the injury, she was continuously disabled and in bed, in a wheel chair, or on crutches for more than 60 days after the injury, and so was unable to comply with the statute.

The court held that, while incapacity caused by the injury would be a ground for allowing a plaintiff to give notice within a reasonable time after he regains ability to do so, it is no excuse for failing to give notice altogether, before bringing suit.

As a result, the City was held not to be liable, regardless of whether or not it was negligent.

### City Garage

In *Dallas v. City of St. Louis*, 338 S.W. 2d 39, a Missouri case decided July 11, 1960, the plaintiff sought to recover \$25,000 damages from the city for the wrongful death of her husband.

He had been employed by the city as a motor vehicle mechanic in the City Refuse Division Garage, which the city operates for the servicing and maintenance of a variety of motor vehicles owned and operated by the city. At the time of

his death, allegedly due to the city's negligence, he was working on and servicing a garbage truck in the garage.

The city defended on the grounds that (1) it was immune from tort liability because this was a governmental rather than a proprietary activity, and (2) in any event, it could not be liable to one of its own employees, even if this were a proprietary activity.

The Supreme Court of Missouri, however, held against the city as to each of these defenses. While the court admitted that the collection of garbage was a governmental activity, it held that the operation of a garage which serviced other city-owned motor vehicles as well was a proprietary activity. Thus the fact that the death occurred while Dallas was working on a garbage truck, as an employee of the city, was not relevant, and the city had no immunity from tort liability.

### Stop Sign Maintenance

*O'Hare v. City of Detroit*, 106 N.W. 2d 538, a Michigan case decided Dec. 2, 1960, was an action by an automobile occupant against the city for injuries sustained in a collision which occurred between the automobile and a bus at an intersection. It was alleged that the collision was caused by the fact that a stop sign at the intersection had been knocked down on the previous day and had not been replaced, thus permitting the automobile to enter the intersection without stopping.

The city defended on the ground of governmental immunity. The plaintiff argued, however, that the doctrine of immunity was not applicable, because the municipality had failed to maintain its streets in a condition reasonably safe and fit for travel as required by the statute. The trial judge held for the city, on the ground that the failure to maintain a stop sign does not come with-

## Heavy Traffic Moves As Buffalo Blasts Rock For New Concrete Distribution Line



East Delavan Avenue in Buffalo gets a lot of traffic on weekdays, and tie-ups were expected when a new 16-inch water distribution line was planned for this street.

But contractor Theodore Bieniek of Eggertsville, N. Y., ran a smooth operation that kept traffic moving at a good pace even while he was blasting through 5 to 6 feet of rock.

It worked like this: Workmen scored asphalt pavement (1), backhoe (2) excavated to rock and loaded truck (3).

Working area (4) was kept completely free of refuse and excavated material. Drilling rig (5) drilled rock for dynamite, and truck crane (6) with a clam shell bucket handled the heavy blasting mats, and removed the loose rock.

Following the placing of a sand bed, the installation of the concrete pipe moved at high speed.

Prestressed concrete steel-cylinder pipe was used on this distribution line because it offers long life, continued high capacity, and has the extra strength

to take the pounding of heavy traffic.

James N. DeSerio was Consulting Engineer for the project. Francis Downing is Commissioner of Public Works and Frank Szuniewicz, Jr. is Director of Water for the City of Buffalo. The pipe was manufactured by Price Brothers Company with Headquarter Plants in Hattiesburg, Miss., and Dayton, Ohio.

**Price Brothers**  
CONCRETE PRESSURE PIPE

**CUT 20" CAST IRON PIPE  
in Less Than 8 Minutes...**



**...with the New REED  
ROTARY CUTTERS**

*(4 sizes cover the range from 10" cast iron to 26" steel pipe)*

These one-man Reed Rotary Cutters cut large diameter steel or cast iron pipe faster and better than the heaviest power machines... and without electrical or explosive hazards. What's more, there's less digging in ditch-work! You need only a 4" to 6" channel under the pipe and a 45° to 60° arc for the handle swing. Reed Rotaries are easy to "carry in", too. The 20" size weighs only 68 pounds; separates into 3 easily carried parts. Patented pipe guide assures clean, right-angle cuts. Four razor blade wheels track perfectly, cut easily and are quickly interchangeable for steel or cast iron pipe.

• Write today for descriptive literature.

*These typical cuts on 12, 16, 20 and 24" cast iron pipe illustrate the clean, accurate, right-angle cuts provided by Reed Rotary Cutters.*



**REED MANUFACTURING COMPANY**  
ERIE • PENNSYLVANIA

in the category of maintaining public streets and highways in reasonable repair.

On appeal, the Michigan Supreme Court held, however, that this does come within the statute, so that the doctrine of governmental immunity is not applicable.

The court also pointed out that it had previously held the following activities to come within the statute, so as to deny governmental immunity: (1) failure to maintain a sidewalk so as to prevent the existence of shallow holes; (2) failure to replace a rotten light pole before it fell; (3) failure properly to ground an electric light pole; (4) failure to guard a hole in a sidewalk under repair; (5) failure to post proper signs, lights or warnings concerning dangerous obstructions or hazards; (6) failure to remove a clothesline string across a public sidewalk, and (7) failure to replace the center post to a safety barrier, which had been broken off.

#### Desalting Plants to Supply Water for Missile Bases

Twelve electrically-powered saline water conversion units will desalt 500,000 gpd of highly mineralized local well water to provide water to 12 Titan and Atlas underground missile bases.

Many of the new intercontinental ballistic missile centers are in arid areas where conveniently available deep well water supplies often contain a high degree of mineralization. The waters to be treated at these sites will range from slightly above the U. S. Public Health Service preferred limits for drinking water up to nearly 6,000 mg/L. The units are being manufactured by Ionics, Inc., of Cambridge, Mass.

Requiring a minimum of attendance, a minimum of chemicals for treatment, and no steam, the Ionics units operate on the "electrodialysis" to "electric membrane" principle. This utilizes small quantities of electrical energy to remove the excess dissolved salts and minerals from water supplies. The low-mineral fresh water to be produced will be used for personnel needs and cooling of special mechanical equipment at the sites. While costs of fresh water production by this method for the missile sites will be higher than normal due to special Government requirements and the small size of many of the units, the electric membrane process is said to be capable of large-scale water production for 20 to 60 cents per thousand gallons on brackish water.



**LLER**  
 or fast,  
 easy  
 service  
 ections!

Write for complete information and specifications.



# New International® Trucks

The most-improved light-duty models  
in INTERNATIONAL history!



New INTERNATIONAL C-130 Series all-purpose dump truck has a GVW rating up to 8,800 lbs. Easy-loading, low-height body handles a variety of hauling problems. Available with 4-speed or automatic transmissions, this series includes stake and platform models, too.

## 7 times better to meet your truck needs

1. Overall height of new INTERNATIONAL models is up to 5 inches lower without sacrificing ground clearance or cab room.

2. Choice of new independent torsion-bar front suspension or I-beam front axle with leaf-type springs for more driver comfort and greater load protection.

3. New hydraulically-assisted clutches in all models ease shifting effort, and also reduce linkage and maintenance.

4. New rigid box section frames or sturdy channel frames take any punishment in stride.

5. Wheelbases are 5 inches longer to improve the ride and give better angle of approach and departure.

6. New contoured grille and restyled sheet metal with sloping hood give you a new look, king-size visibility.

7. Seven regular models with GVW ratings from 4,200 to 8,800 lbs.—plus the special new model C-100—present a complete light-duty line-up.

Stop in today at your INTERNATIONAL Truck Dealer or Branch for the whole story. Drive and price the new INTERNATIONAL light-duty models.



Your most reliable worker can be a new INTERNATIONAL with standard pickup body. Sand-tight box with sturdy all-steel construction throughout. Ribbed floor lessens the friction when loading or unloading. Body lengths of 7 and 8½ feet. V-8 engine power is standard, "sixes" and more powerful V-8 optional. All-wheel-drive models available—let you go anywhere, anytime.

# INTERNATIONAL TRUCKS

WORLD'S MOST COMPLETE LINE

International Harvester Company, Chicago • Motor Trucks • Crawler Tractors  
Construction Equipment • McCormick® Farm Equipment and Farmall® Tractors

PUBLIC WORKS for March, 1961



**WHAT A DIFFERENCE!**



**What a beautiful difference**  
**P & K ALL-ALUMINUM**  
**LIGHTING STANDARDS**  
**can make in any community**

This is High Street, Pottstown Borough, Pa., a busy shopping section and a major traffic artery. As part of a planned relighting program, Philadelphia Electric Company replaced the old-fashioned, inadequate cast iron standards with modern, 30-foot tapered aluminum standards by P & K; replaced the incandescent luminaires with mercury vapor.

The difference is tremendous — by night, safe well-lit streets that are an invitation to shoppers; by day, handsome, modern looking standards that reflect a progressive community. And, it's good to know that P & K standards never need painting or other costly maintenance.

For the complete data on P & K street and area lighting standards, please write.



**PFAFF & KENDALL** 84 Foundry Street, Newark 5, N. J.

*Branch Sales Office: San Jose, California*

*In Canada: Powerlite Devices LTD., Toronto, Montreal, Vancouver*

*Export Representative: Philips Export Co., New York, N. Y.*



**No Loafers, No Part-Time Workers  
On This Job...**



*2 New Ford  
Industrial Rigs!*



**New FORD 2000** Industrial tractor has 48.4 engine horsepower (gasoline), heavy front end, power steering, foot throttle—easily handles this 10' Ford backhoe and new Ford 720 Loader. Try this unit for low first cost, low fuel bills, fast maneuvering in tight spots.

**New FORD 4000** Industrial tractor has all the high production features of the 2000 but with 62.5 horsepower plus added weight and strength. High powered and rugged, the 4000 makes tough jobs easy with this new Ford 720 Loader and a 12' backhoe.



# These Bright NEW Ford Rigs are **ALL-DAY, ALL-JOB** **WORKERS**

The paint is new but that's not all... here are a couple of lean and brawny middleweights with new productivity, versatility, dependability. These new Ford rigs don't sit around on their big fat tires half the day... they dig, load, backfill, grade—handle a dozen jobs from either end. A 2000 or 4000 is small enough to get in tight places, strong enough to do the job. They're *sized right* between light and heavy equipment... *priced right* down among the lowest of their kind... *built right* to do more good jobs for you...

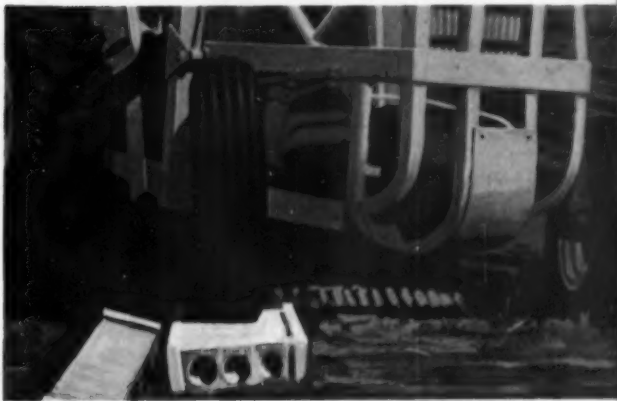
**NEW High-Lifting Half-Yarder**—Half-yard struck capacity bucket, 2000 lb. lift, 4000 lbs. break-out capacity. High-speed, cool-operating hydraulics and Ford's fast tractors permit fast, sustained loading... responsive 4-position controls and a handy bucket level indicator provide accurate digging, grading, loading.

**Far Reaching Backhoes**—Pick the size you need—10' or 12' for either unit... each Ford backhoe attaches quickly, has big buckets, precise controls, wide stance stability and fast, strong hydraulics... the 10' size digs 10'8" deep, and reaches out 17'4" from the axle... the 12' size digs 12'5" deep and reaches 19' from the axle... Ford backhoes are unmatched for length of trench dug from one setting!

**Ford Pays Half** your diesel fuel bills—buy a diesel-engined Ford 2000 or 4000 and Ford pays half your fuel bills for the first six months or the first 400 hours—whichever occurs first. Fords are famous as fuel misers and now you can cut operating costs even more. Offer good to March 31, 1961 on any new Ford or Fordson diesel. See your Ford dealer for details.



Downshift on-the-go with Select-O-Speed to bull in, bring out a heaped payload...



One-piece rugged cast steel I-beam front axle moves heavy loads over curbs, across ruts.



High lift—long reach of loader dumps into the center of your standard truck.

**FOR 101  
INDUSTRIAL JOBS**

# FORD

COPYRIGHT 1960 FORD MOTOR COMPANY

## BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

*Ford Motor Company,*

2500 E. MAPLE ROAD

BIRMINGHAM, MICHIGAN

ATTN: Industrial Sales

FIRST CLASS  
PERMIT NO. 119  
BIRMINGHAM,  
MICHIGAN

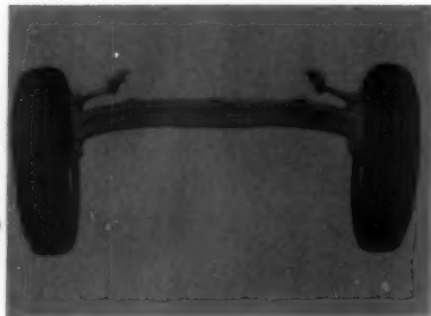
# FORD WORKS FULL-TIME FOR YOU

...and here's why:



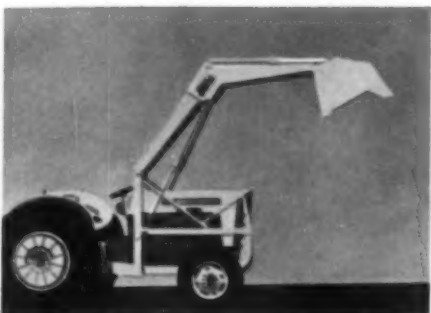
**Dependable Power** comes from Ford's proven gasoline, diesel or LP-gas "Red Tiger" engines.

**Curb Jumper, Rut Rider**—5000 lb. rated capacity front axle, larger, rugged spindles, heavy drag links, powerful power steering, big 7.50:16, 6 ply tires—this front end is built to soak up the pounding of heavy work.

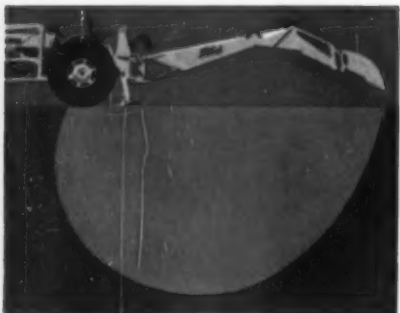


**Slashes Labor Costs**—Dig by machine, not by hand! All Ford backhoes undercut as far back as the tractor's rear axle to reduce hand digging; all have accurate controls for precision digging around existing lines, other obstacles.

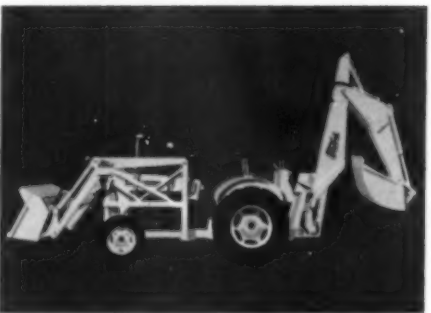
**Fast Truck Loader**—12 second cycle, bucket position indicator, 45° dump angle, 14° roll-back, long reach, high dump heights, short over-all length—fast truck loading is this unit's specialty.



**All Day Comfort**—One step up swings you onto the cushioned seat . . . power steering kills ground shocks, handy foot accelerator speeds production.



**Tailored to Your Jobs**—Pick your transmission: 4 speed, reversing, 12 speed—over under, or Select-O-Speed . . . pick your fuel . . . pick your tires . . . choose from 7 loader buckets, 6 backhoe buckets, 5 stabilizer types . . . and choose from a long list of extra equipment for special jobs. These new Ford rigs *can* be your all-day, all-job workers.



Send me information on:

☐ Ford 2000 Industrial tractor

☐ Ford 4000 Industrial tractor

☐ Ford 720 Loader

☐ Ford 10', 12' backhoes

☐ Send name of nearest dealer

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

POSITION \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_



Looking for something even bigger?  
Check Ford's big 4000 Industrial Tractor

SEE YOUR NEAREST

# FORD

TRACTOR AND EQUIPMENT DEALER



# BYERS GUIDE

Tips on Reducing Corrosion Costs from A. M. Byers Company VOL. 2 NO. 2



Drainage lines on the Calumet Skyway are of Byers 4-D Wrought Iron. Included are 14", 16" and 18" O.D. pipe fabricated from Wrought Iron plate. The use of 4-D will reduce corrosion problems due to sodium chloride and cinders to a minimum.

## There are Ways to Combat Snow and Ice on Bridges... but

Salt and cinders are often necessary to improve hazardous driving conditions, but these two materials also have a detrimental effect. The ice and snow becomes saturated with sodium chloride and acid bearing cinders which are deadly to drainage lines on bridges and overpasses.

The extremely corrosive conditions resulting from salting and cinderling virtually "eat up" ordinary pipe, but don't get far with 4-D wrought iron pipe.

That is one reason why engineers specified nearly 400 tons of 4-D wrought iron for drainage lines for the Calumet Skyway in Chicago, a vital link between the toll road network and Chicago. The specification called for 4-D wrought iron pipe in various sizes as well as 135 tons of

4-D wrought iron plate for 14, 16 and 18 inch O.D. pipe.

The key to wrought iron's corrosion resistance is the iron silicate slag which is threaded throughout the base metal. There is approximately 250,000 of these silicate slag fibers in every square inch of the two component metal. Each fiber serves as a barrier to corrosion. In addition to halting the attack of sodium chloride or acid bearing cinders, 4-D wrought iron resists corrosion caused by alternately wet and dry conditions.

In some states, highway engineers have standardized on wrought iron for such applications as drainage gutters, downspouts, scuppers and curbing. Test results and application reports are available—simply check the coupon.

## Under-Water Water Line

Carrying water from a pumping station west of Lake Worth, Florida, to an intercoastal distribution waterway, a 10-inch diameter Byers 4-D Wrought Iron pipe line passes right under Lake Worth. 4-D was chosen because of its superior corrosion resistance, especially in salt water, and also because of the ease with which it can be welded at the site. Since Wrought Iron forms its own protective coating, a tightly adherent layer of oxides, no protective wrap was necessary.



## Wrought Iron Conduit Buried in Sidewalk

Conduit to carry power lines to industrial plants in West Hartford, Connecticut, were installed by the Hartford Electric Light Company. Since a new bridge was also a part of the plans, the conduit was to be buried in the bridge sidewalk. Two six-pipe banks of 4-inch threaded and coupled 4-D conduit, totalling 3,200 feet, were used in this installation. Byers 4-D Wrought Iron was selected because of its proven corrosion resistance in applications of this type. Full details are yours for the asking—use the coupon.

### A. M. BYERS COMPANY



PIPE PRODUCTS: Wrought Iron • PVC • Steel  
ROLLED PRODUCTS: Plates, Billets and Bars •  
Wrought Iron, Stainless and Alloy Steel

A. M. Byers Company, Clark Building, Pittsburgh 22, Pa.

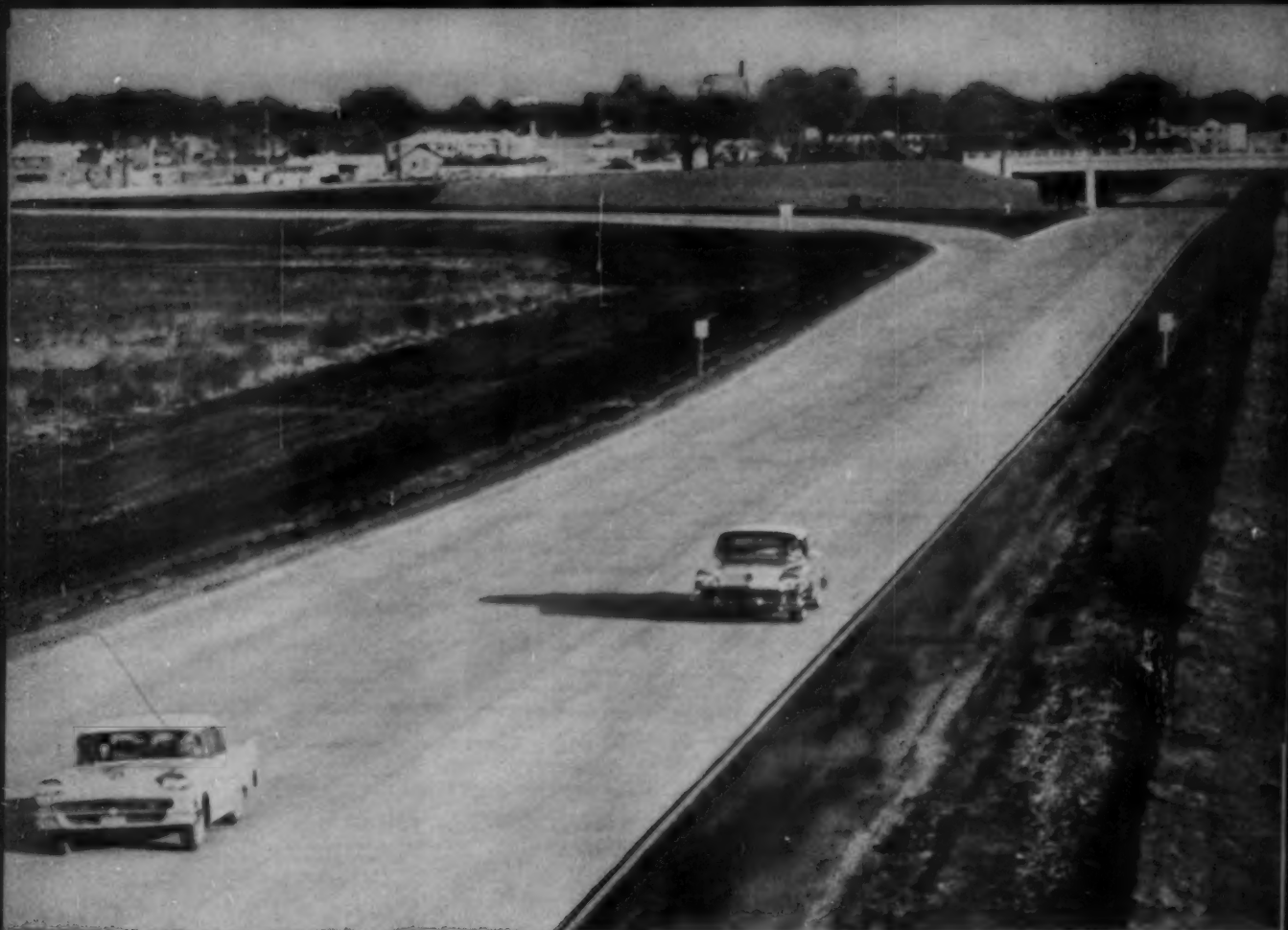
Please send data on items checked:

☐ DRAIN LINES ☐ CONDUIT ☐ PIPE LINES

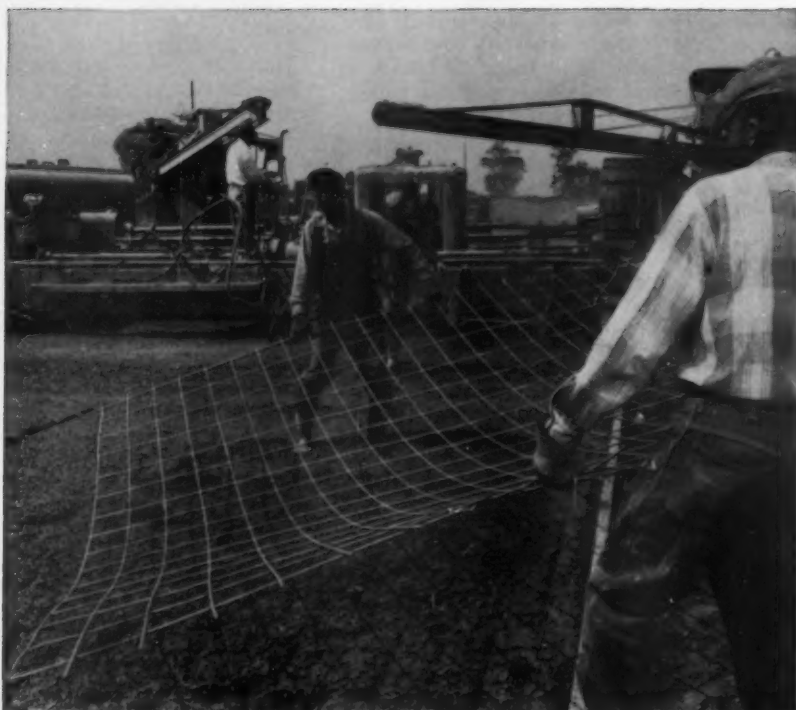
Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_



# Steel reinforced ...to stand up



**PROJECT:** Portion of Northwest Expressway just west of Cumberland Avenue Interchange, Cook County, Illinois

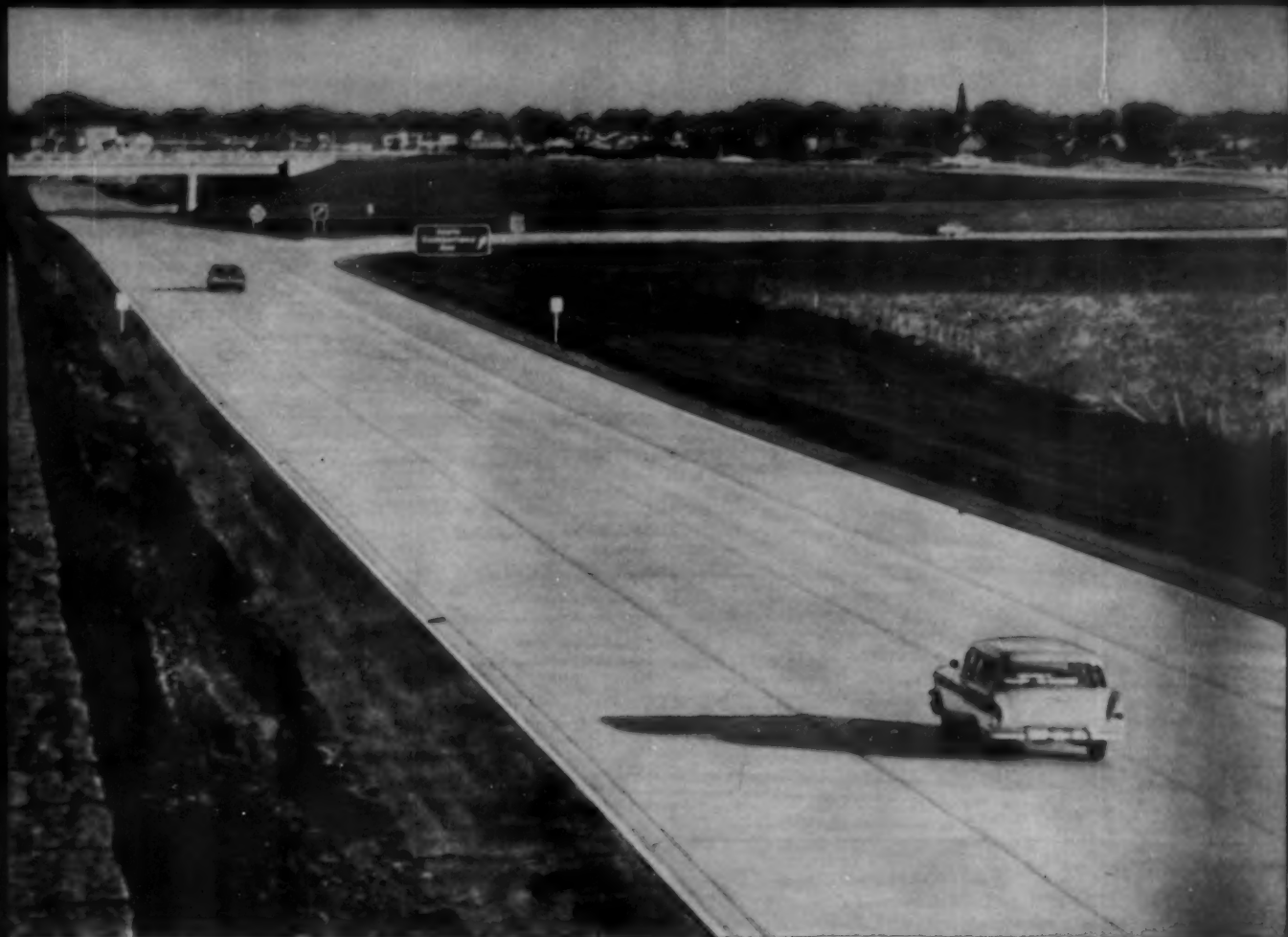
**OWNER:** Cook County Department of Highways

**CONTRACTORS:** Arcole Midwest Corp., Evanston, Illinois

**WIRE FABRIC DISTRIBUTOR:**  
E. W. Zimmerman, Inc., Chicago, Illinois



This mark tells you  
a product is made of moderr,  
dependable Steel.



## under the hi-speed pounding of modern traffic

Cook County, Illinois has opened the first section of its new Northwest Expressway. And, like other expressways built under the authority and supervision of that county's Department of Highways, it is steel reinforced.

An anticipated daily count of 31,000 vehicles is expected on this newly opened 4½-mile section which extends from Foster & Central Avenues to the Illinois Toll Highway. This figure indicates what this already busy strip will be subjected to as the traffic load gets heavier. And it points up the importance of building into all new roads and highways the strength it will take to stand up under the almost ceaseless pounding of modern hi-speed traffic in the years ahead.

Highways reinforced with steel have a balanced

design in that all edges and corners are fully protected. USS American Welded Wire Fabric accomplishes distributed load transfer and reduces stresses about 30% which accounts for the truly superior performance of reinforced concrete over non-reinforced concrete. Reinforced pavements provide a safe, smooth riding surface that lasts.

USS American Welded Wire Fabric is today stronger than ever. Minimum tensile strength is now 75,000 psi and minimum yield point is now 60,000 psi. It has reserve strength for heavier pounding and it is available in a completely machine fabricated form, ready for immediate placement. For more information, write to American Steel & Wire, 614 Superior Avenue, N. W., Cleveland 13, Ohio.

*USS and American are registered trademarks*



**American Steel & Wire  
Division of  
United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors  
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors  
United States Steel Export Company, Distributors Abroad





**Quiet, vibration-free mowing** at higher speeds is yours with the new International balanced head cutter bar mower.



**Cut a 10-foot swath** with combination of International rotary and cutter bar mowers. Use together or independently.



**Only a Cub tractor can do so much** for such a small investment! Above, equipped with 60-inch International Danco rotary.

## More mowing for your money

*at your IH tractor dealer*

From grooming neighborhood playgrounds to mowing miles of expressway median, today's public officials are faced with a complexity of mowing problems. Selecting the right equipment to meet these varied requirements can help stay within manpower and equipment budgets on the one hand, and favorably influence public opinion on the other through improved community appearance.

**You can save hundreds of dollars**, for example, if you specify an International® Cub instead of a larger tractor that can do no more on a multitude of small-area mowing jobs. At the other extreme, you cut high-mileage mowing costs to the bone when you use a 61 hp\* IH tractor with 94-inch, center-mounted rotary mower. Where fuel costs are important, specify 38, 47, and 61 horsepower Internationals with Diesel engine.

\*Maximum engine hp at standard conditions

**Ask your IH Dealer**—He'll gladly supply complete specifications covering the industry's widest range of tractor horsepower ratings, with matching cutter bar, rotary, and other types of mowers. See for yourself why you get the most for the money with Internationals!



**INTERNATIONAL HARVESTER**

PUBLIC WORKS for March, 1961



# Ask the men who use them

(there are many in your area)



## Rockwell Sealed Register\* "Magnetic" meters

Ask nearby water utilities for *their* experience using Rockwell Sealed Register *magnetic* meters. We'll bank on your getting an enthusiastic testimonial from actual buyers and users.

Hundreds of thousands of these "magnetic" meters are now in service.

\*Trade Mark

Please accept this challenge to "ask the men who use them." Write us and we will be glad to send you a list. Rockwell Manufacturing Company, Dept. 162C, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

***Imitated, but never equalled!***

**SEALED REGISTER® METERS**

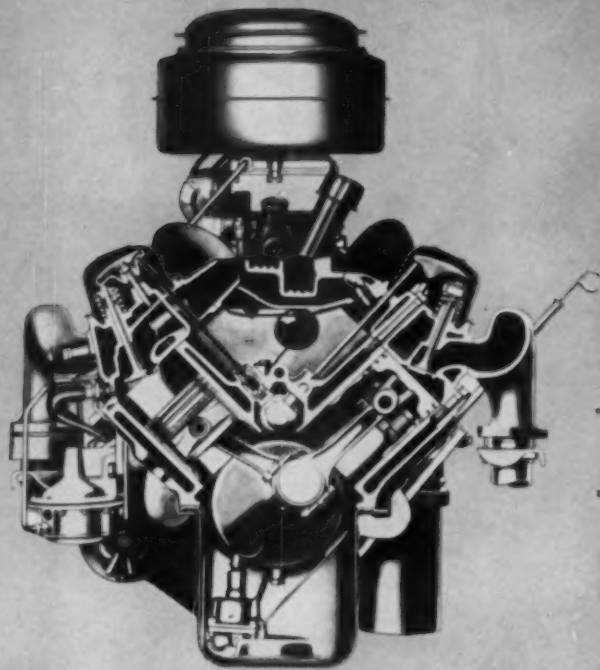
another fine product by

**ROCKWELL**

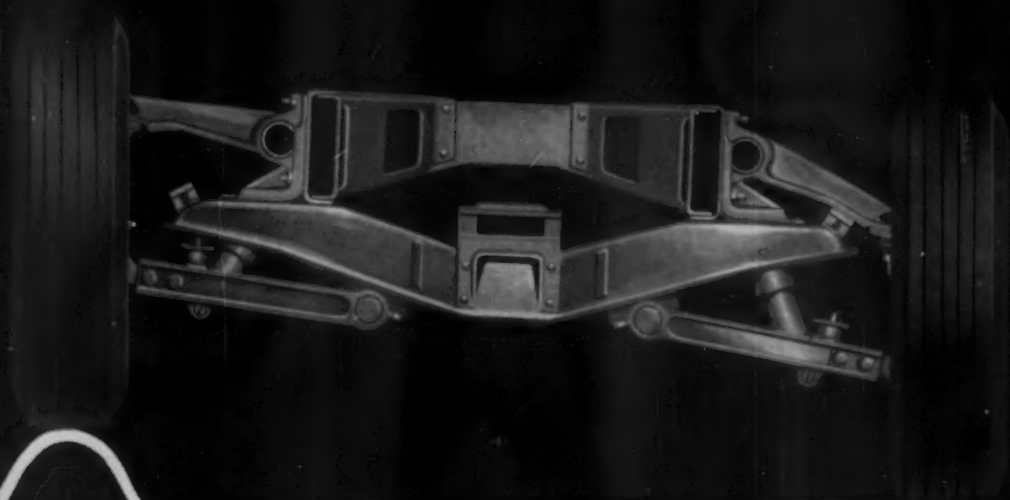




- 1** Extra strength where it counts gives Chevy cabs rock-solid rigidity to stay in shape years longer.



- 2** Chevy's powerful, efficient Taskmaster V8 combines big-truck might and muscle with top operating economy.



- 3** Independent Front Suspension with "walking wheel" action paves the way to bigger earnings with a smoother ride and reduced maintenance expense.

# DEEP-DOWN DURABILITY SAVES YOUR DOLLARS IN 1961 CHEVROLET MEDIUM-DUTY TRUCKS

Here are Chevy components that add to tough-truck durability and earning ability; the *strong* reasons why a Chevrolet middleweight can take plenty of punishment—and keep on taking it. Here's why these rough-and-ready haulers squeeze bonus earnings out of tight budgets!

**1** Take a look at the Chevy cab (pictured at left). It's built *solidly* to take any poundings your rough-and-tumble runs can throw its way; to stay in shape for years, lengthen effective truck working life and minimize maintenance expense. Notice the husky longitudinal sills that reinforce the cab underbody to reduce vibration and provide a solid foundation for cab sheet metal. Check the extra sturdy door openings with box-section pillars and sills to keep doors weather-tight and in lasting alignment. See how the husky box-section pillars support the rigid, double-walled roof panel for greater safety and maximum cab strength. (And this cab is just as *comfortable* as it is rugged!)

**2** More evidence of Chevy's deep-down strength and toughness can be found beneath the hood. There you'll find the 261-cubic-inch Jobmaster 6—a work-proved dollar-saver. Its sturdy components—forged steel crankshaft, high-alloy inlet valves, precision bearings, hard-faced exhaust valves with Rotocoils, all-weather electrical system and many more—are solid assurance of maximum efficiency and economy. Or the big 283-cubic-inch Taskmaster V8 illustrated at left (optional at extra cost) to supply plenty of torque to move maximum payloads with minimum strain or wear. Low maintenance costs stem from features like aluminum high-alloy inlet valves, hard-faced exhaust valves with Rotocoils and Moraine 400 precision bearings.

**3** Chevy's bump-beating Independent Front Suspension system provides still another reason for dollar-saving durability. Tough, friction-free torsion springs cushion the ride; ruggedly built control arms guide each wheel to give sure, stable handling; sturdy, custom-tailored shock absorbers further reduce road shock and offer maximum ride control. The result is a new kind of smooth truck ride that lengthens truck life; cuts wear and tear to reduce maintenance. These reasons for ruggedness go on and on to help reduce your costs. They're all the result of Chevy's *deep-down durability*. See your dealer about it soon. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.



CHEVROLET POWERMATIC, developed especially for big truck duty, provides fully automatic driving ease for all Series 60 and 60-H models (optional at extra cost). With six forward speeds in four driving ranges, plus torque converter action for getting under way and cushioning drive-line shifting shocks, Powermatic adjusts automatically to load and road conditions.

## 1961 CHEVROLET STURDI-BILT TRUCKS

**CHEVROLET**



*Where others fail...*  
**B-I-F** time-duration telemetering  
*is infallible!*

Miles apart . . . pressure drops, a flow rate changes, a pump fails, a valve sticks . . . all must be instantly, dependably recorded at one central data-gathering station. As infallible as time itself . . . normal variations in line voltages, resistance, inductance, or ambient temperatures do not affect the B-I-F system. Power loss doesn't call for readjustment. Physical quantities are measured in their own terms . . . response is faster . . . need for elaborate off-normal alarm equipment is eliminated . . . all at great savings in cost! From the simplest tank level recording to complex central data handling, B-I-F has the know-how and experience in teleme-



tering and remote control to help you operate more efficiently. Compare B-I-F Chronoflo Telemetering with any other. Request Bulletin 230.20-2 for complete details. Write B-I-F Industries, Inc., 356 Harris Avenue, Providence 1, Rhode Island.



**Industries**

BUILDERS-PROVIDENCE • PROPORIONEERS • OMEGA  
METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING



# NOW-GPX<sup>®</sup> ACRYLIC OVERLAID

Conforms to Commercial Standard CS 45-60

## WHITE-GREEN BLUE-RED

Colors conform to Am. Assn. of State Highway Officials' Manual

### 4 new permanent colors in GPX plywood

- GPX is now available with acrylic overlay ... in permanent colors of green, white, blue or red. Order it in any combination of colors front and back, or with natural or black high density one side.

- Resists severe weather and abuse. Won't rust or corrode. Can be fabricated with wood-working tools. GPX costs less, lasts longer

than metal. Reflective sheeting bonds better to overlaid plywood surface.

- Strong, stiff panels light, easy to handle. Require minimum backing and framing.

- 1-piece panels up to 60" x 120", larger scarfed panels also available.

- Write today for free sample, complete data.



**GEORGIA-PACIFIC**

Dept. PW361, Equitable Building, Portland, Oregon • plywood • lumber • redwood • hardwood • pulp • paper • chemicals

PUBLIC WORKS for March, 1961

# Save on construction costs with the new '61 FORD TRUCKS

## SAVE FROM \$22 TO \$260 ON PRICE\* ALONE WITH FORD'S ECONOLINE PICKUP

Profit-conscious contractors are finding it's good business to do business with the new Ford Econoline Pickup. It's America's lowest-priced\*  $\frac{1}{2}$ -tonner—bar none! Priced from \$22 to \$260 below conventional pickups. But that's just the beginning! You get lively performance and proven gas economy with the popular 144 cubic inch Falcon Six. This modern engine goes 4,000 miles between oil changes, and has an aluminized muffler which lasts up to three times as long as ordinary mufflers.

**And you can save more** because Ford's functional design has pared away 1,000 pounds of dead weight, yet you still get the payload capacity of standard  $\frac{1}{2}$ -tonners. The big 7-foot box provides a whopping 73 cubic feet of loadspace . . . that's up to 23% more than conventional

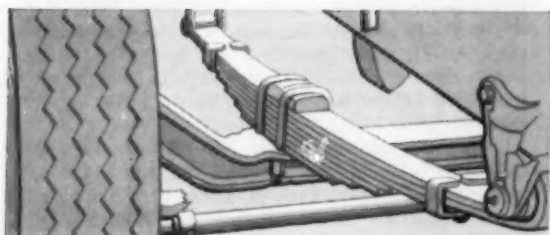
6 $\frac{1}{2}$ -foot pickups. A full 49-inch tailgate opening means you can load items like standard sheets of 4' by 8' plywood. And the full-length flat floor permits bulky or heavy loads to be positioned easily by sliding them anywhere in the pickup box.

**And you can save on maintenance** expense, too. The engine cover can be lifted quickly, exposing the entire engine for rapid service. Spark plugs, distributor, etc., are conveniently located to speed engine tune-ups. And many major repairs can be made without ever removing the engine. One-piece cab-and-body construction provides increased rigidity and eliminates a major source of rust. In addition, all main underbody structural members are heavily zinc-coated to resist rust and corrosion.



**New Ford Econoline  $\frac{1}{2}$ -ton Pickup.** Big 7-foot box with flat floor and 73 cu. ft. of usable loadspace. 1,650-lb. payloads with 4,350-lb. maximum GVW.

\*Based on a comparison of latest available manufacturers' suggested retail delivered prices



**SAVE UP TO \$250 ON FRONT TIRES!** In certified tests of two-ton truck suspensions, Ford front tires lasted over twice as long. In 40,000 miles this saving can add up to \$250 . . . more as the mileage increases. And Ford's sturdy I-Beam front axle and leaf-spring suspension not only cut tire wear, but their simpler design also cuts maintenance costs.

**12,000 MILE  
OR 12 MONTH  
WARRANTY**

**SAVE WITH GREATER DURABILITY . . .** on all 1961 Ford Trucks, each part, except tires and tubes, is now warranted by your dealer against defects in material and workmanship for 12 months or 12,000 miles, whichever occurs first. The warranty does not apply, of course, to normal maintenance service and to the replacement in normal maintenance of parts such as filters, spark plugs and ignition points. Never before have you had such protection . . . such evidence of long-term economy!

## **SAVE WITH FORD'S NEW 262-CU. IN. "BIG SIX" ALL-TRUCK ENGINE FOR TOP PERFORMANCE AND ECONOMY**

America's lowest-priced\* medium-duty tilt-cab models now offer a big 262-cubic-inch Six with the power of big displacement, the gas economy of 6-cylinder design, plus the durability of heavy-duty construction. This engine features a sturdy stress-relieved head and block, strong forged steel crankshaft, long-lasting stellite-faced intake and exhaust valves and durable pyramid-type connecting rods. Positive Crankcase Ventilation reduces oil dilution and sludge formation to extend engine life. Ford's proven 292 V-8 and 292 HD V-8—the V-8's with "six-like" economy—are also available for your special power needs.

The popular Ford Tilt Cab Series outsells all other makes and for good reason! Their compact 82-inch BBC permits longer bodies within a given over-all length . . . for longer loads of lumber and building materials with excellent maneuverability. And set-back front axle design means more weight is carried on the front axle for greater payloads.

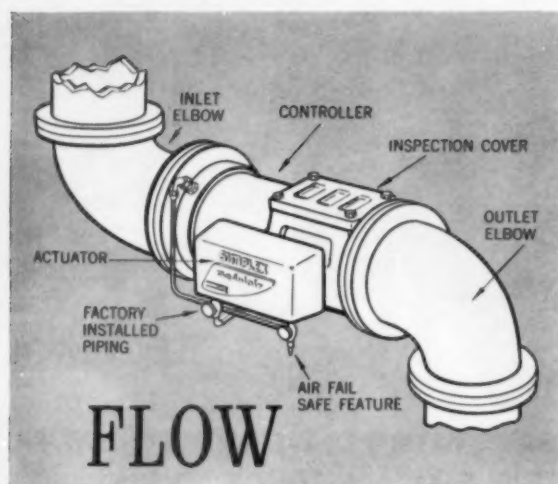
You also save with other new features like the stronger radiator with new lock-seam construction, and color-coded printed instrument panel electrical circuits that provide for greater reliability and simplified maintenance. In addition, Ford's parallel ladder-type frame, with standard 34-inch width, allows you to install new or transfer your present special construction bodies quicker and for less.

# **FORD TRUCKS COST LESS**

**YOUR FORD DEALER'S "CERTIFIED ECONOMY BOOK" PROVES IT FOR SURE...**

FORD DIVISION, *Ford Motor Company.*





## How to control it economically with this simple, modern "box on a pipe."

This is the Modulaire Type "P" rate-of-flow controller, for your filter effluent piping.

You install it almost as easily as a piece of pipe, and its design is so utterly simple that you have almost no maintenance cost.



Note how Modulaire "P" flow controller requires very little space in filter effluent line.

In fact, the minute you put this venturi-actuated, fully pneumatic controller to work, you get these new savings:

1. No valve operator
2. No water supply
3. No hydraulic valves
4. No drive gears and linkage
5. No "spaghetti" of complicated piping
6. No pilot valve or valve shaft
7. No leaky packing gland
8. No floor drain
9. Almost no maintenance

You save space, too, because the "P" controller has the shortest laying length of any, in addition to being entirely preassembled, with all working parts enclosed.

Send for our Bulletin 951, for details on space and cost savings of the "P" controller. Compare them with your present method of flow control. No obligation.

# **SIMPLEX**

VALVE AND METER COMPANY

a division of PFAUDLER PERMUTIT INC.  
Lancaster, Pennsylvania

**Ed Cleary Says:**

## Pleasure-Boating Interests Are Taking the Lead In Curbing Sewage Pollution

**EDWARD J. CLEARY**

Diplomate, American Academy of Sanitary Engineering  
Cincinnati, Ohio

COMPARED WITH the magnitude of untreated wastes from communities and industries, it might be conceded that the sewage discharged from pleasure boats is of small dimensions in any measure of the over-all water pollution problem. Nevertheless, boat pollution does command attention in terms of local and future implications, particularly on small waterways or in moorage areas.

It is gratifying to report, therefore, that attention has been given to the matter, and that progress is being made to deal with it. These conclusions stem from attendance at a meeting of the American Boat and Yacht Council, Inc., in New York City last month. The council is an independent standards-development organization representing a variety of interests in the design, manufacturing and servicing of pleasure boats and facilities.

The January meeting was the seventh to be held in as many years, during which the ABYC has co-operated in promoting action on pollution control. Credit for enlisting ABYC in this laudable activity goes to the New England Interstate Water Pollution Control Commission. The Commission initiated and sponsored these annual conferences with the boat industry, starting in 1955; it has now relinquished its leadership to the ABYC but continues to serve in advisory capacity.

It was at the behest of one of its signatory states, New Hampshire, that the New England commission approached the boating industry seven years ago and asked for help in developing a sewage-treatment device for marine heads (toilets). Within a year after this request the ABYC found itself able to present to the New England commissioners a treatment tank and chlorinating device suitable for small boats developed by one of the manufacturers.

Impressed with the practicality of this device, and eager to take steps to protect its inland lakes, the State of New Hampshire adopted regulations in 1957 concerning marine-toilet effluents. This law, incidentally, is the first of its kind in the U.S.A. Among other things it requires such effluents to:

- (a) Be free of unsightly solids;
- (b) Contain a most probable number (MPN) of coliform bacteria not exceeding 240 per 100 milliliters.

Anticipating that other states would be contemplating legislation with regard to boat pollution, the Council of State Governments drafted a suggested "model law" in 1958. This is based in large measure on the New Hampshire law.

But coming back to the ABYC: At succeeding meetings called by the New England commissioners progress was made in developing tentative standards and in improvement of equipment to meet these



standards. The improvements included a macerator for sewage solids to promote more thorough disinfection. At the meeting last month it was stated that three miniature sewage-treatment units were now available for installation on small boats, and a fourth type is soon to be announced.

### Planning for the Future

Equally important to future prospects for control of boat pollution are the steps that have been taken by ABYC to acquaint boat designers and manufacturers with needs and how they can be met. For example, in the standards adopted by the council, it is recommended that a space of at least 24 x 14 x 17 inches be allotted on all new boats to accommodate installation of sewage-treatment devices.

Those who are familiar with boats will recognize the importance of this recommendation. A boat represents the ultimate in compactness—only genius and small thumbs make it possible to put so much in such little space. If no provision has been made for a sewage-treatment unit there is little likelihood that it can be incorporated in an existing boat without expensive modification. Therefore, by implementing this design recommendation the boat manufacturers will have anticipated future requirements and thus facilitated compliance with regulations.

Consequently one must applaud what has been accomplished by the inspiration of the New England interstate commission and the labors of the American Boat and Yacht Council. They have gone a long way in preparing to ease the burdens of both boat owners and regulatory agencies in securing compliance with pollution-control measures.

### How Much of a Problem?

Further evidence that the boating fraternity is alive to its obligations on sewage disposal comes from the Outboard Boating Club of America. Representatives of the OBC at the New York City meeting recalled their efforts since 1959 in circulating a model act to acquaint state legislators and others with the nature, scope and draftsmanship of appropriate regulations. The model act is based substantially on the New Hampshire statute which, in turn, was endorsed by the Council of State Governments. Now the OBC is campaigning among boat manufacturers urging that provision be made on all new water-craft for the installation of sewage-treatment facilities.

Expressing wholehearted support of the move to safeguard waters from boat pollution, the OBC said it was puzzled, however, on the lack of data to indicate where and when such pollution was a problem. Conditions on the Missouri River were cited as an example. How, asked the OBC spokesman, could pollution from pleasure boats be considered a hazard when untreated sewage from major cities and wastes from industries continued to pour into this waterway?

Another aspect of pollution from boats—namely that resulting from the exhaust of outboard motors—was outlined at the conference by Gerald McDermott, research specialist of the Taft Sanitary Engineering Center, Cincinnati. Mr. McDermott made an interim report on a laboratory study dealing with the composition of exhaust residues. This revealed that the exhaust was the source of measurable quantities of lead, phenols and oils. But field studies are required to supplement laboratory findings, said Mr. McDermott, to establish properly the significance of engine

## REFLECTORIZATION... HELPING HAND IN TRAFFIC

# Safety



Reflectorized center lines, no passing zone lines, edgeline markings, traffic signs and other reflectORIZATION are today regarded as "musts" in the cause of safety.

And with Flex-O-Lite Beads maximum protection is afforded because Flex-O-Lite Beads are lighter by day—brighter by night—the result of years of experience that assure greatest possible reflectivity throughout a longer life. This marked difference in quality is evident in the complete line, including:

- **Traffic Beads**—Free-Flowing, Moisture-Proof, Standard and Type H Safety Spheres.
- **No. 831 Lead-Free High Index of Refraction Beads and Sign Kits.**
- **UB 68 Lead-Free Medium Index of Refraction Beads.**
- **Traffic and Sign Bead Dispensers**—Automatic and Semi-Automatic types.



**FLEX-O-LITE MANUFACTURING CORP.**

8301 Flex-O-Lite Drive, St. Louis 23, Missouri • Paris, Texas

Flex-O-Lite of Canada, Ltd., P. O. Box 216, St. Thomas, Ontario, Canada

## HOW TO BUY THE BEST CHIPPER FOR YOUR NEEDS

**1 Ask for a Free Demonstration.** Your dealer will gladly demonstrate the new 1961 Asplundh... will even run it side-by-side with any other chipper to let you compare machines and results.

**2 Look for the features that give you these benefits.**

**Chipping Speed.** By actual test Asplundh is the fastest chipper made—which your dealer will gladly prove.

**Low maintenance cost.** The Asplundh has fewer moving parts. This means lower maintenance, less down time.

**Safety to workers and passers-by.** Asplundh blades are tapered and wedged—cannot fly out.

**Ease of operation.** Unskilled labor can operate the Asplundh with ease—change blades quickly.

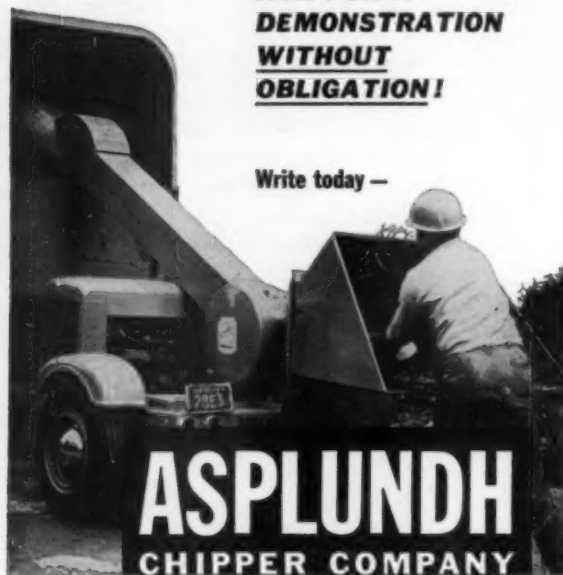
**Highway safety.** Asplundh's underslung engine and axle place the center of gravity low for safe, true highway tracking.

**Big capacity.** Asplundh chips all you can feed it—limbs up to 6" diameter—hour after hour, day after day.

**3 See for yourself why Asplundh outsells all other makes.** Write for new brochure of testimonials from satisfied users.

**ASK FOR A  
DEMONSTRATION  
WITHOUT  
OBLIGATION!**

Write today —



**ASPLUNDH  
CHIPPER COMPANY**

HAMILTON ST., CHALFONT, PA.

Proven in service by the world's largest tree company

exhaust and water-quality degradation. Indications are that the residues could produce taste-and-odor conditions as well as the tainting of fish flesh.

### Some General Observations

To this observer the question of sewage disposal from boats might be viewed in this fashion:

On small lakes, and on larger lakes whose waters may be used untreated for water supply, there are obvious reasons to regulate the disposal of wastes from boats and shore-side facilities.

The same urgency for installation of sewage-treatment devices on pleasure boats using larger rivers or plying coastal waters does not exist. And to insist on such provisions in areas where municipal and industrial waste sources of pollution have not yet been curbed would be unrealistic.

Harbors and mooring areas can be rendered unattractive because of boat sewage. However, this problem can be minimized without requiring treatment devices on every boat. The alternate solution is to provide adequate toilet facilities on docks or floats, and to equip these with appropriate treatment units. One of the largest and most crowded municipal harbors in Southern California has adopted such a procedure. To enlist cooperation, harbor officials have signs placed at strategic points with this provocative slogan: "Don't use your head in the harbor."

Looking to the future, it would be a happy circumstance for state pollution-control authorities to provide ample warning to their intention to regulate the discharge of sewage from boats. For reasons previously cited, compliance will be burdensome, and a time delay (say 2 to 3 years) for regulations to become effective would be desirable. In drafting such legislation good guidance will be found in the model statutes prepared by the Council of State Governments, 1313 East 60th Street, Chicago (37), Ill., and the Outboard Boating Club of America, 307 North Michigan Avenue, Chicago (1), Ill.

One matter presently overlooked in boat-pollution prevention legislation is a prohibition to curb the almost universal habit of throwing overboard anything not wanted on the boat. Admittedly, this practice in disposal of boat garbage and trash may be of small consequence in degrading water-quality. But the river-litter-lout can be quite a factor in contributing to the untidiness of our waterways. While Title 33 of the U.S. Code concerning the disposal of refuse into navigable streams provides stiff penalties, there has been little, if any, disposition by federal authorities to enforce this long-established prohibition except in some major harbors.

Not the least of the burdens that face state agencies with regard to boat-pollution control relates to the establishment of an effective inspection system. The futility of legislation that is not conscientiously enforced is stressed by representatives of the Outdoor Boating Club of America. Quite possibly pollution-control boards may find it useful to delegate this responsibility to their state agency charged with boat licensing. Starting last year a number of states undertook this licensing function which heretofore was a federal function under Coast Guard jurisdiction.

As a final comment, congratulations should be extended to the New England Interstate Water Pollution Control Commission for having inspired the attention already given to the problem. And these plaudits would include the American Boat and Yacht Council, Inc., under whose auspices the task has been advanced, as well as the National Associa-

# NEW

**engine  
power**  
BY CATERPILLAR



**NEW  
KW**

**NEW  
HP**

**CAT D343**  
gives you outstanding  
performance at an unmatched  
price per horsepower

Turbocharged-Aftercooled D343 provides 420 HP maximum at 2000 RPM, electric set produces up to 250 KW.  
Turbocharged only—360 HP maximum with electric set ratings to 200 KW.

## CHECK ALL THESE MONEY-SAVING ADVANTAGES:

### SUPERIOR FUEL ECONOMY

- As low as 0.387 lbs. per brake horsepower hour

### OUTSTANDING PERFORMANCE

- 420 HP maximum . . . up to 250 KW
- Modern design . . . Turbocharged and Aftercooled
- Four valves per cylinder with individual porting
- Precise valve action with twin overhead camshafts
- Complete combustion through four-cycle design . . . full stroke power

### LOW OPERATING COSTS

- Foul-free operation . . . large single-orifice fuel injectors
- Efficient burning of wide range of fuels because of pre-combustion chamber design

### LONG LIFE

- Performance-proved Caterpillar-quality components
- Maximum cooling efficiency . . . wet-type cylinder liners, constant-spray-cooled pistons, high water-flow head
- Large-capacity dry-type air cleaner . . . double oil and fuel filtration systems

### EASE OF SERVICE

- Tinker-free fuel system . . . no adjustments needed
- No valve train mechanism with twin overhead camshafts

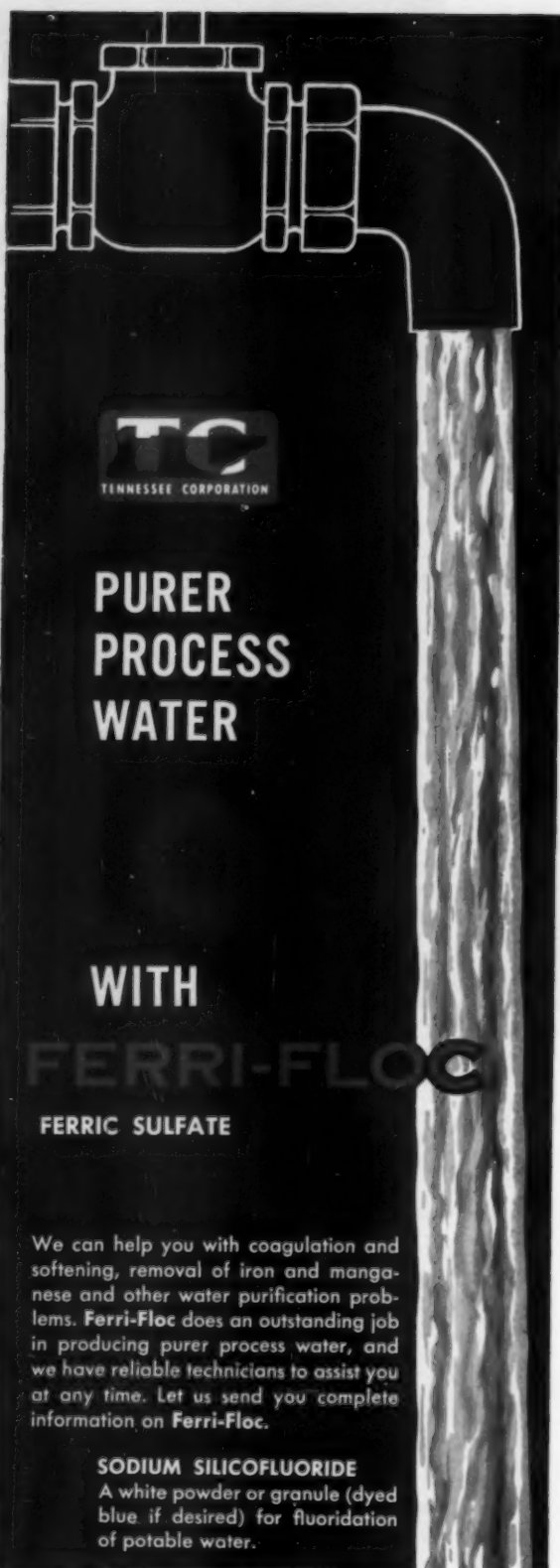
*All Caterpillar Engines are backed by over 800 sales, parts and service outlets throughout the Free World. Call your Caterpillar Dealer or write us direct for complete specifications on the new D343.*

# CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Caterpillar Tractor Co., Engine Division, Peoria, Illinois, U. S. A.





**TC**  
TENNESSEE CORPORATION

**PURER  
PROCESS  
WATER**

**WITH  
FERRI-FLOC**

**FERRIC SULFATE**

We can help you with coagulation and softening, removal of iron and manganese and other water purification problems. Ferri-Floc does an outstanding job in producing purer process water, and we have reliable technicians to assist you at any time. Let us send you complete information on Ferri-Floc.

**SODIUM SILICOFLOURIDE**  
A white powder or granule (dyed blue if desired) for fluoridation of potable water.

**TC** **TENNESSEE CORPORATION**  
TENNESSEE CORPORATION 811-629 Grant Building, Atlanta 3, Georgia

tion of Engine and Boat Manufacturers and the Outboard Boating Club of America who are joined in these efforts. This leadership to prevent the possibility of pollution from some 8,000,000 pleasure boats commands the appreciation of all those who are striving to promote the national crusade for clean waters.

## Engineering Notes

### Population per Water Service

According to the latest annual report (for 1959-60) of the Water Department of Pasadena, Calif., the population of the city was 115,764 according to the April, 1960, preliminary Federal census. The population served in unincorporated territory was 21,335, making a total population served of 137,099. Dividing the population by the number of services gives a factor of 3.47 persons per service in the city and 3.28 persons per service outside the city. Both of these factors are less than 3.6 persons per service determined after the Federal Census count for each of the years, 1920, 1930, 1940, and 1950. The reduction within the city may be due to the increased number of large apartment buildings and an increase in the number of services to commercial and industrial establishments.

The average consumption of water in the system during 1959-60 was 200.9 gallons per capita per day. This represents a decrease in the per capita use during the past year of 4.9 gallons per day and an increase in the per capita use since 1942 of 81.4 gallons per day.

### Cost of Mixed Refuse Collection and Disposal

The cost of mixed refuse collection and disposal in Baltimore, Md., was \$8.84 per ton in 1959. Collections were made two days each week of garbage and rubbish combined. Of the total of 324,812 tons, 317,974 tons were incinerated; 738 tons were hauled to a landfill; and 6,099 tons were dumped. In addition, private haulers brought 94,117 tons to the incinerators. Cost figures include maintenance, depreciation on motor equipment and 18.4 percent overhead. Tonnages are based on actual weights.

Incineration costs were: For No. 3 incinerator \$2.380 per ton for 175,111 tons, the cost including maintenance, depreciation and 15.8 percent overhead; for No. 4 incinerator, the cost was \$1.828 per ton for 249,719 tons, including maintenance, depreciation and 16.95 percent overhead.

Ash collection was provided twice a week during the heating season and once a week in the summer, using open dump trucks. Collections amounted to 45,847 cu. yds., and cost was \$5.38 per yard, including overhead and depreciation.

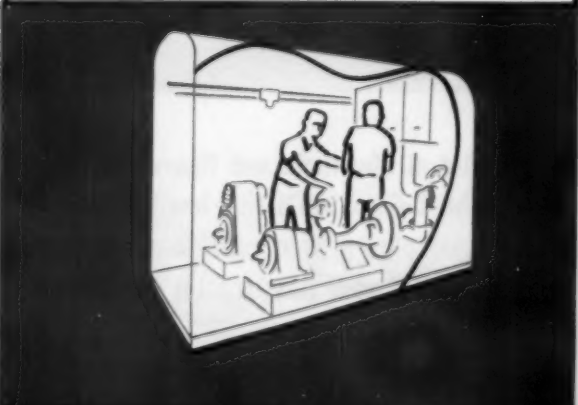
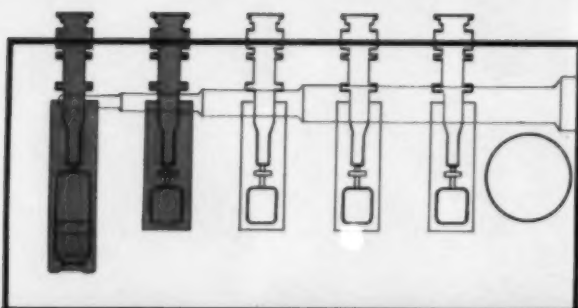
### Costs of Sewage Treatment Plant Components

The improvements made in 1959 and 1960 to the Alliance, O., sewage treatment plant cost \$703,896, of which \$631,264 represented construction costs. Costs of various of the items making up the plant were: Reinforcing \$33,786; iron, steel and copper pipe \$45,540; gratings, railings, fence, etc., \$24,259; valves, gates and hydrants \$27,632; wiring and lighting \$37,175; pumping equipment \$12,164; and sludge collecting equipment \$18,500. Concrete in place cost \$93,429.





# ...shaped for GROWTH!



The new, *rectangular shape* of the TEX-QUAD Packaged Pump Station is designed to meet the needs of a growing community. It permits a larger sewage pumping station to be installed with only **TWO** pumps *initially*. Then, as the area to be served increases, additional pumps can be quickly, easily and inexpensively installed to handle the increased load. There's ample space in the TEX-QUAD for as many as **five pumps**, providing added capacities up to **10,000 GPM!**

Operators find normal servicing and maintenance of the TEX-QUAD sewage pumps stations easier, too. The unique, *rectangular design* creates a *more spacious interior*. This is one of the important reasons why TEX-VIT stations are today's "*best buy*" for any community.

## TEX-VIT

**MANUFACTURING COMPANY**

*Formerly TEX-VIT Supply Company*

P. O. BOX 117-P MINERAL WELLS, TEXAS

Write today for the new TEX-QUAD CATALOG No. TQ-61. It gives complete information on this new, rectangular **Packaged Pump Station**.

# Better service accessibility alone makes the "Euc" C-6 your best tractor buy

In the Euclid C-6 crawler you get the advantages of job proved components and years-ahead engineering that keeps down-time and operating cost to the absolute minimum. You get unitized assembly of major components and service accessibility that is unsurpassed by any crawler . . . replacement labor costs are well below those for comparable tractors. For example, complete removal and replacement of a C-6 radiator takes less than one third of the time required for the same work on a competitive machine.

With easy accessibility for servicing and maintenance, the C-6 gives more work-time on the job . . . steps up production . . . helps beat the profit squeeze by cutting operating costs to a new low.

**EUCLID Division of General Motors**  
Cleveland 17, Ohio



*Plants at Cleveland and Hudson, Ohio  
and Lanarkshire, Scotland*



*Full-power shift...this Euclid C-6  
crawler responds like nothing  
you've ever touched!*

**Get all the facts and figures on  
the C-6 . . . you'll find low operating  
cost plus proven reliable performance  
make it your best tractor investment.**



 "Euc" C-6 gives you the advantage   
of easier servicing **plus**  
these top performance features:

**PROVEN POWER**  
**PROVEN TORQMATIC DRIVE**  
**FULL POWER SHIFT**  
**COMMON STEERING-BRAKING**  
**FAST-AS-A-FOX RESPONSE**  
**EXCEPTIONAL MANEUVERABILITY**

Brief specifications... 211 net h.p. delivered to power train... torque converter and semi-automatic transmission... independently suspended final drives... oil cooled multiple disc brakes... dry type air cleaner... 7 track rollers on each side... rear-mounted radiator.

A NEW DESIGN CONCEPT THAT SETS NEW STANDARDS FOR PERFORMANCE AND LOW OPERATING COST IN THE 200 H.P. TRACTOR CLASS



**EUCLID**

FOR MOVING EARTH, ROCK, COAL AND ORE



## repair hydrant traffic damage **FAST**

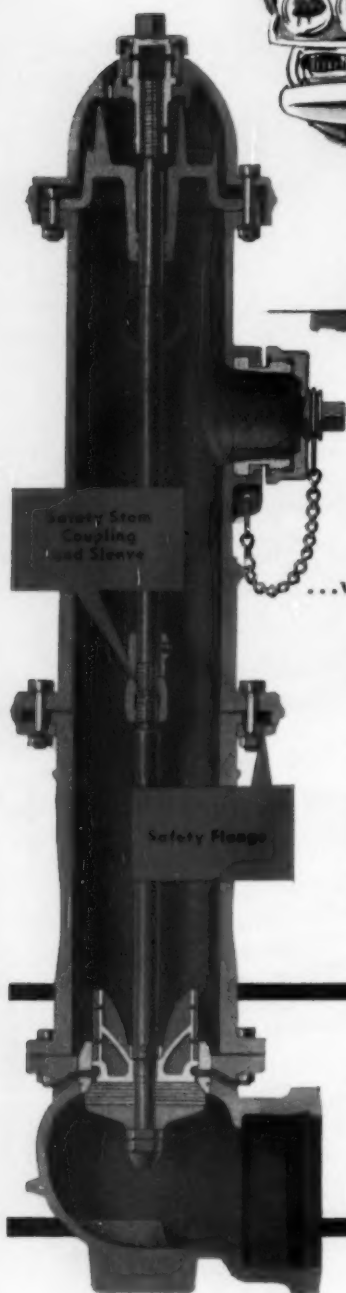
...without loss of water...without water shut-off...without digging

The Mueller AWWA Improved Fire Hydrant is quickly put back into action when knocked over.

Mueller's Safety Flange design prevents breakage of the hydrant barrel and bent or broken operating stem. Hydrant safety mechanism snaps off cleanly just above the ground line.

The compression-type main valve stays closed. No water is lost to affect pressure at neighboring hydrants. No damage is caused by flowing water. Lower stem section is held solidly in place to permit easy repair without digging.

The simple, inexpensive repair kit shown below contains all parts needed to completely restore hydrant to service in a matter of minutes.



### Safety Flange Repair Kit

Consists of safety flange, safety stem coupling, safety flange gasket and can of Mueller hydrant lubricating oil.

Write for  
complete information  
and specifications.

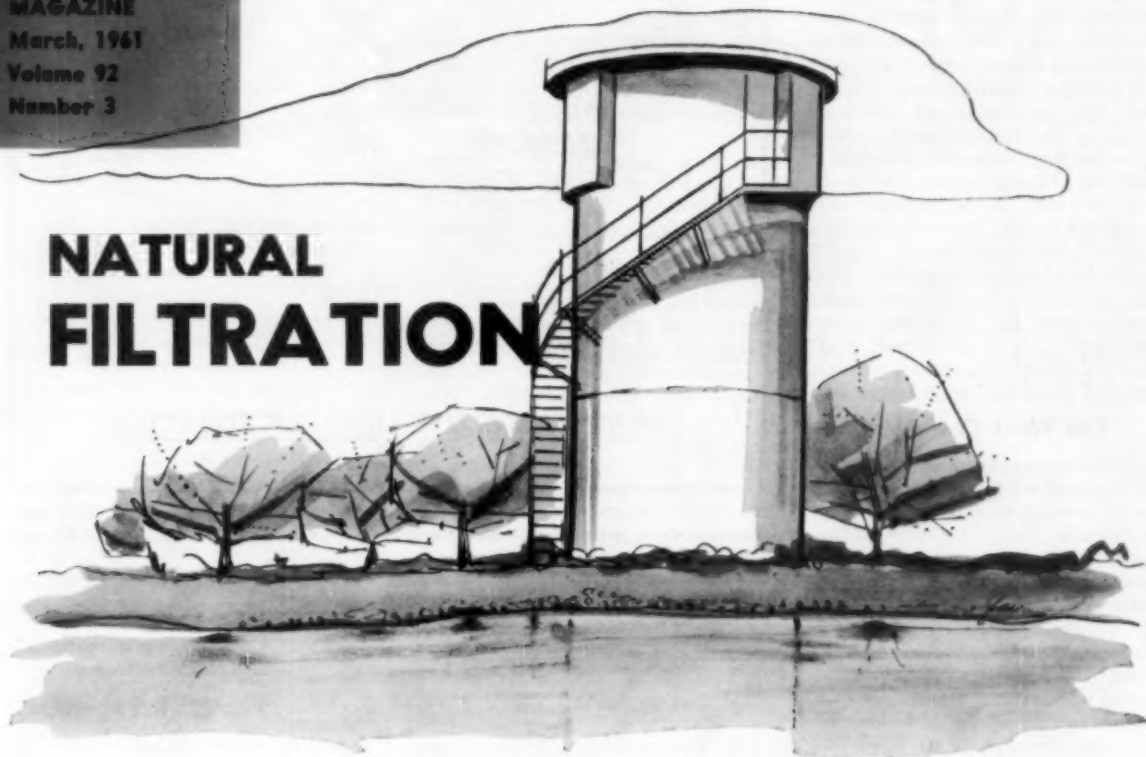


**MUELLER CO.**  
**DECATUR, ILL.**

Factories at: Decatur, Chattanooga, Los Angeles  
In Canada: Mueller, Limited, Sarnia, Ontario



## NATURAL FILTRATION



When a booming residential community is carved out of an agricultural area, it faces a water problem if the major source is a river. Carmichael, California, discovers an economical method of obtaining water of drinkable quality.

### JOHN McALLISTER

Mr. McAllister was General Manager of the Carmichael County (Calif.) Irrigation District when this article was prepared. He has since moved to Mexico.

**T**HE POST-WAR growth of California cities has resulted in a remarkable face changing of much of the countryside surrounding these cities. Carmichael, California, an unincorporated community lying to the East of Sacramento, is typical of this change. It was formerly an agricultural area, consisting mainly of small orchards and ranches, but the trend to suburban living has resulted in the creation of a rapidly growing residential community with large size lots and room for expansive lawns, home gardens and swimming pools.

In the 10-year period following World War II, the population of the

area trebled, while within the past five years the population has again doubled, bringing it to the present estimated 20,000. Among the many problems created by these changes that of the water supply stands out first and foremost.

The water supply of the area is furnished by the Carmichael Irrigation District. Organized in 1916, the District initially obtained water for irrigation and domestic use by a direct diversion from the American River. Untreated water was pumped from the river and delivered to the users through redwood stave pipes. By 1957, the water system had been expanded until it consisted of two river pumping stations, three vertical deep wells, and approximately 57 miles of water mains.

As of 1957, two sources of supply were being used by the District, surface water from the American River and ground water from deep alluvial formations. The surface

water supply, the major source, was still being pumped directly from the river, the treatment consisting only of intake screening and chlorination prior to delivery into the system. The water produced was of unsatisfactory quality because of turbidity, taste and odors, or bacterial contamination. The turbidity ranged at times as high as 55 units. Fragments of fish and other aquatic life have been reported in the water supply, and decay of organic matter in the distribution system created undesirable tastes and odors. Bacteriological tests of the water in the distribution system have frequently shown contamination indicating that chlorination alone was ineffective in killing coliform and associated microorganisms.

### Studies Conducted

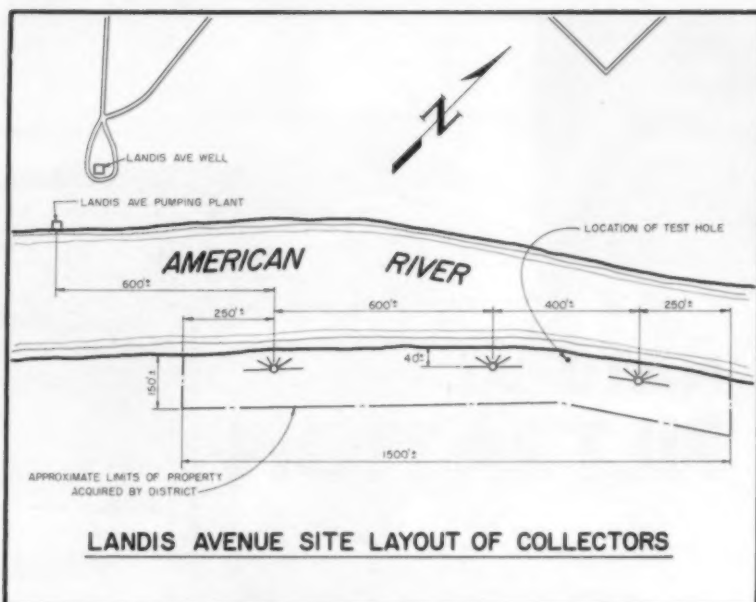
Recognizing the health hazards of continued use of unfiltered surface water supply, the District, operating

under the direction of Chairman W. E. White and Board Members R. L. Lambert and W. L. Wagner, in the summer of 1957, authorized the firm of Dewante and Stowell, Sanitary and Civil Engineers, Sacramento, California, to make an engineering study of the water system and to present the most feasible plan for developing an adequate supply of satisfactory quality water.

Studies by the engineers indicated that the ultimate population of the area presently being served or to be served in the future by the District will reach a saturation of 43,000 people by about the year 2000. With this population, the ultimate water requirements for the District were estimated at a peak demand of 52 mgd and an average annual requirement of about 13.5 mgd.

### Ten Plans Considered

Although ten plans for developing the required supply were considered, the differences in many of the plans represented only slight modifications and fundamentally the various schemes can be resolved to three basic patterns: Plan A, utilization of American River water by the construction of a complete filtration plant and additional deep wells in fringe areas; plan B, utilization of American River water by natural filtration through construction of Ranney Collectors and additional deep wells in fringe areas; and plan C, complete ground water supply by construction of additional deep wells. Later studies of ground water conditions in the Carmichael area indicated the ground water supply was inadequate to supply the ultimate requirements and therefore plan C was eliminated from further consideration.



● THREE collectors were constructed at the Landis Avenue site and one at a location about two miles downstream. Together they are designed to supply about 24 mgd.

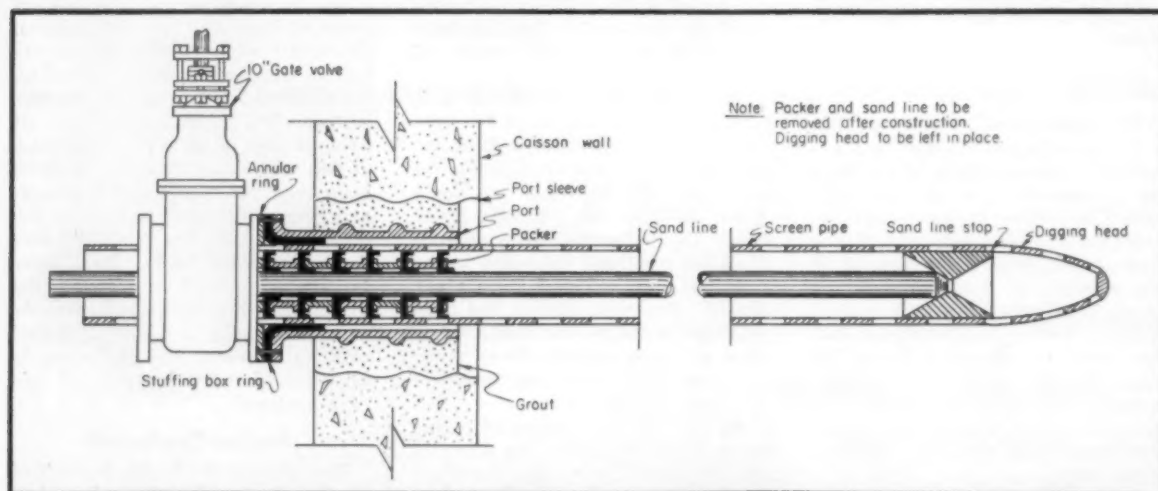
Initial cost estimates of the two plans, based upon developing a supply of 20 mgd from the American River were \$2,242 million for plan A and \$0.892 million for plan B. Distribution system improvements were considered, too, these being estimated at \$0.571 million if plan A were used and \$0.614 million with plan B.

In addition to these initial costs, the annual maintenance and operating costs were estimated as \$208,500 for plan A and \$164,000 for plan B. In view of the economies favoring plan B, not only in the savings in initial costs but also in the continuous, annual savings of about \$45,000 per year in maintenance and operat-

ing costs, this plan was recommended for development of the District's water requirements.

### Collector System

The major feature of the selected plan consisted of developing an infiltrated water supply from the American River by the construction of Ranney Collectors. This unique method of developing large volumes of naturally filtered surface water utilizes natural gravels and sands, as they exist, for the slow infiltration of water derived from a surface source and as a river or lake. If the hydrogeological conditions are suitable, that is, natural gravels and sands underlie the bottom of a river



● DETAIL SECTION showing the 8-inch diameter slotted screen pipe and accessories used for construction.

or lake, then water produced by the collector will be replenished by water from the surface source. The important element is the existence of unconsolidated deposits of sand and gravel in hydraulic contact with the river. A hydrogeological survey is necessary to determine the existence of such hydraulic contact as well as to evaluate the quantitative and qualitative characteristics of any given site.

The advantage of the Ranney method of development is the removal of a large amount of fine materials around each horizontal screen, the number and length of which can be designed at will to suit any given aquifer, so as to establish a zone of very high permeability throughout the entire area of development. The development of a large area of very high permeability next to a river or stream permits infiltration of the water derived from such a source at a very low velocity. This low velocity of infiltration and considerable thickness of the filter medium (usually not less than 20 feet and in many cases more than 100 feet), combined with bacteriological purifying action taking place at the surface of the river bed, results in the production of water free from turbidity, organic matter and pathogenic bacteria; that is, water that does not require any treatment with the exception of preventive chlorination if desired or required by state law.

In the fall of 1958, the District engaged the firm of Ranney Method Western of California, Inc., to conduct hydrogeological investigations and, if suitable geologic conditions were found to exist, construct a system capable of producing a firm water supply of acceptable quality of 24 mgd.

Because of the shallow depths and extreme local variations in character and areal extent of the sand and gravel deposits adjacent to the American river, an extensive survey was necessary. A total of 42 test holes and observation wells were drilled and 6 detailed pumping tests were conducted. The results of the investigation showed that the required water supply could be developed by the construction of four Ranney Collectors.

Construction was started in November, 1958, and completed in August, 1959. Each collector consists of a vertical circular shaft (or caisson), 13 feet in diameter with 18-inch reinforced concrete walls. The caissons were sunk, by open excavation methods, into the underlying sands and gravels to variable depths below

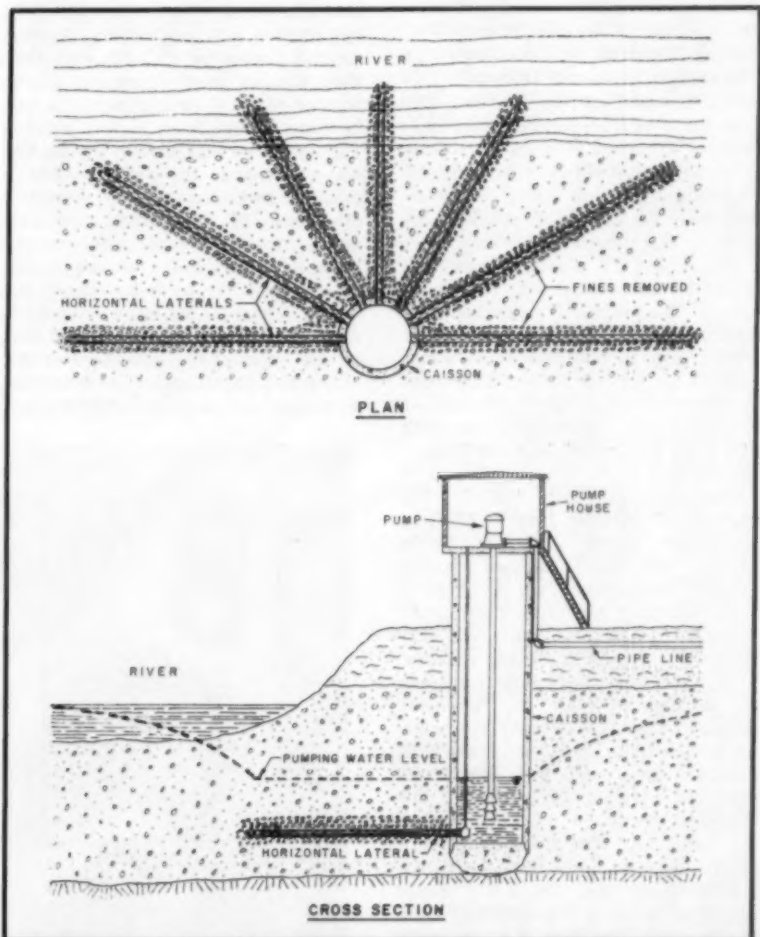
ground surface, ranging from 21 feet to 46 feet. A concrete plug (or seal) was installed in the bottom of each caisson.

At depths of approximately 20 feet below river level, five to seven horizontal screen pipes or laterals were extended from each caisson in a semicircular pattern. The screens consist of 8-inch diameter standard steel pipe, having slotted openings measuring  $\frac{3}{8}$  inch by 2 inches, and varying in length from 23 to 90 feet. The total length of horizontal screen laterals in the four collectors is 1,539 feet.

The concrete caissons were extended above ground to a height of 2 feet in excess of the highest expected flood level. On the top of each collector is an attractive concrete block building which houses deep well turbine pumps and electrical equipment. The pumps are designed to operate automatically, thereby minimizing maintenance and servicing.

The area started receiving water from the new system in September, 1959 and, after one year of operation, the supply is exceeding all expectations as to quantity and quality of water produced. Within the short space of two years from the time the project was first conceived, the water supply of the District has changed from one that was subject to continual complaints from customers and the State Health Department to that of a high quality water.

The water produced is clear and odorless. Although the water meets all sanitary requirements, small amounts of chlorine are added as a safeguard. Small amounts of lime are also added to protect pipe lines from corrosion. However, neither practice affects the taste of the water. The economies of the new water system are such that the entire project is being financed without the necessity of an increase in either water rates or taxes.



● SKETCH of a typical Ranney collector showing the pump house, caisson and horizontal laterals. Extended caisson holds pump house above anticipated flood levels



# Operating Characteristic Curves of Standard Portland Cement Tests

W. E. HASKELL

NEARLY all of the Portland cement used in public works such as highways, bridges, dams and defense projects, is purchased on the basis of the results of tests performed on samples of the material before it is accepted or placed in the structure. Such tests may be chemical, physical, or both and are usually performed by the consumer or his agent. The specifications and test methods used in the examination of the cement are practically always those of the American Society For Testing Materials and the American Association of State Highway Officials or modifications thereof. The practice is now so common and universally accepted that there is little or no argument about its advantages or pecuniary value and it is therefore easy to disregard specific defects in the general scheme.

The standard cement tests referred to are divided into two categories. The physical tests include: Initial setting time in hours; final setting time in hours; autoclave expansion in percent; air entrainment in percent; compressive strength at 3 days (psi); compressive strength at 7 days (psi); and fineness, Blaine, sq. cm, per g.

The chemical tests include the percent of: Silicon dioxide ( $\text{SiO}_2$ ); aluminum oxide ( $\text{Al}_2\text{O}_3$ ); ferric oxide ( $\text{Fe}_2\text{O}_3$ ); calcium oxide ( $\text{CaO}$ ); magnesium oxide ( $\text{MgO}$ ); sulfur trioxide ( $\text{SO}_3$ ); sodium oxide ( $\text{Na}_2\text{O}$ ); potassium oxide ( $\text{K}_2\text{O}$ ); ignition loss; and insoluble residue.

The physical tests are intended to determine that the physical properties of the cement are such as to produce strong and durable concrete when used with sound and properly graded aggregates; the chemical tests are made to assure the consumer that the constituents of the cement have been correctly proportioned and thermally combined to produce the specified type of cement. The test for insoluble residue will determine the presence of some types of adulterants and the

test for ignition loss will indicate any excessive exposure to aeration.

In recent years, it has been remarked in technical literature, that some of the properties of Portland cement, particularly the uniformity, are not as good as is desirable. It has not been sufficiently emphasized however, that a major reason for this can be attributed to obvious deficiencies in the standard specification requirements and in the test methods themselves.

The principal counts against the present standard specification requirements are inadequacy, unreasonable looseness and the fact that they are not based upon any scientific, or rational testing plan (as will be brought out later in this paper). The most serious deficiency in the test methods is the rather extraordinary fact that their inherent attributes of reliability, precision and accuracy have heretofore never been properly and adequately determined, so far as is known to the writer. There is for example only a single published research\* (and that a very recent one) which has even attempted to estimate the precision of any of the standard cement test

methods by the use of modern statistical techniques.

Unless the attributes of a test method are known it is impossible to develop a testing plan with given characteristics; and it is also impossible, without this information, to determine the characteristics of any testing plan in actual use. This leads to the rather disturbing conclusion that up to the present time we actually know little or nothing about the attributes of the standard test methods or about the operating characteristics of any of the testing plans now used for judging the quality of Portland cement. In this paper, the characteristics of certain testing plans for Portland cement will be reported as operating characteristic (OC) curves and a short explanation and interpretation of the curves presented. The first curves are those for plans utilizing ASTM Method C114-58T, "Sodium and Potassium Oxide by Flame

\*J. R. Crandall and R. L. Blaine, "Statistical Evaluation of Interlaboratory Cement Tests," Proceedings of the American Society for Testing Materials, Vol. 59 (1959)

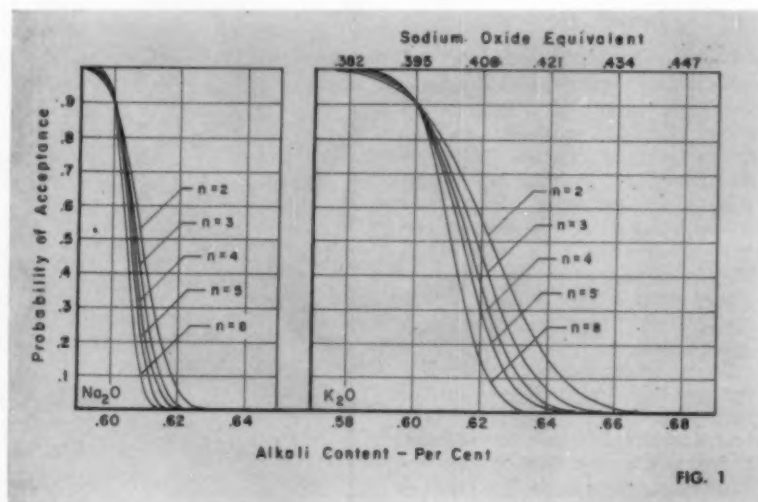


FIG. 1

● IN THE family of curves above, a producer's risk of 5 percent has been used. These curves for  $\text{Na}_2\text{O}$  and  $\text{K}_2\text{O}$  were based on the use of ASTM Methods C114-58T.



Photometry Using the Direct-Intensity Method."

OC curves cannot be constructed unless the precision of the test method is known, and the publication of such estimates, in the paper cited previously, make the present paper possible. The actual percentage point values for  $\text{Na}_2\text{O}$  and  $\text{K}_2\text{O}$ , taken from that paper are: For  $\text{Na}_2\text{O}$ —0.010; for  $\text{K}_2\text{O}$ —0.025.

### Test Methods and Testing Plans

A test method is a description of all of the apparatus, conditions and operations that are used in the performance of a test on a given material. The results obtained from the use of such a test method may or may not be reliable, precise and accurate. It is therefore often stated that a test method itself does or does not have one or more of these attributes.

A testing plan includes not only the test method, but also specifies the producer's (and usually the consumer's) risk, the acceptance limit or limits and the exact number of completely independent replicate tests that are to be performed on the sample of material. In this paper the operating characteristic curves for ten testing plans for each of the two alkalis will be given.

### Characteristics of Testing Plans

Keeping in mind the fact that all test methods have an inherent and inescapable variability, called the precision, the two important characteristics of a testing plan are that it should provide reasonable and definite assurance 1) to the producer or vendor that his material will be accepted when it does in fact con-

form to specification requirements and (2) to the consumer that such material will be rejected by the plan when it does not in fact conform to specification requirements.

In this article the words "acceptable" and "unacceptable," and "good" and "bad," are used in the sense that a material does or does not conform to specification requirements.

The probability that a good material will be rejected by reason of the inherent variability of the test method is called the producer's risk. It is designated by the lower case Greek letter alpha ( $\alpha$ ) and is expressed either as a decimal fraction, or a percent ( $\alpha = 0.05$  or 5 percent). Its actual magnitude in any testing plan should be decided by mutual agreement between both parties involved in the exchange of the material or in a specification requirement. So far as the writer knows, no specifications for Portland cement have ever considered or mentioned either producers' or consumers' risks. In any event, if a test method is reliable, and if its precision is known, it becomes possible to design a testing plan with a built-in producer's risk. It does not follow, however, that all such plans will necessarily be practical or economical. It deserves to be emphasized here that a producer is justly entitled to a small producer's risk and that the consumer or specification writer must or should take this fact into consideration. In this paper the OC curves are drawn for producer's risks of 5 and 10 percent.

If the producer of a material is entitled to a small producer's risk, the consumer or buyer is likewise

entitled to a small consumer's risk. This means that a good testing plan will also assure him (the consumer) that the probability of accepting material which does not in fact conform to specification requirements will be small. The probability of accepting bad material on account of the inherent variability of the test method is the consumer's risk and is designated by the lower case Greek letter beta ( $\beta$ ). A reasonable value for this risk is often considered to be 10 percent.

A good testing plan is then simply one in which producers and consumers risks are reasonably small and which is reasonably economical to perform.

### Operating Characteristic Curves

Curves which show the probability of acceptance as ordinates and a range of values of a specified physical or chemical property of a material as abscissas, based on a given producer's risk, are called operating characteristics (OC) curves. Because a testing plan for the alkalis by flame photometry is of such unusual interest to both producers and consumers of cement it will be discussed briefly.

In most instances manufacturers find it relatively easy to meet specification requirements but this is not always the case. It occasionally happens that some of them may have a great deal of difficulty in doing so and must go to considerable trouble and expense in order to bring their product into conformity with the specification requirement. An excellent example of this situation occurs in the Portland cement industry where it is often necessary to manufacture cement in which the alkali content ( $\text{Na}_2\text{O}$  and  $\text{K}_2\text{O}$ ) is held at a low figure.

Some cement manufacturers are fortunate in having raw materials with naturally low alkali content. This is not true of all of them and for those who do not it becomes necessary to modify the manufacturing process with a consequent increase in manufacturing costs. This leads to a situation in which the consumer specifies that the material shall have a maximum of, say, 0.60 percent of alkalis. The cement manufacturer tries to keep the alkali content slightly below this figure, since part of his manufacturing costs will be inversely proportional to the reduction he is obliged to make in the natural alkali content of his product.

It is obvious then that every cement manufacturer and every consumer of low alkali cement should

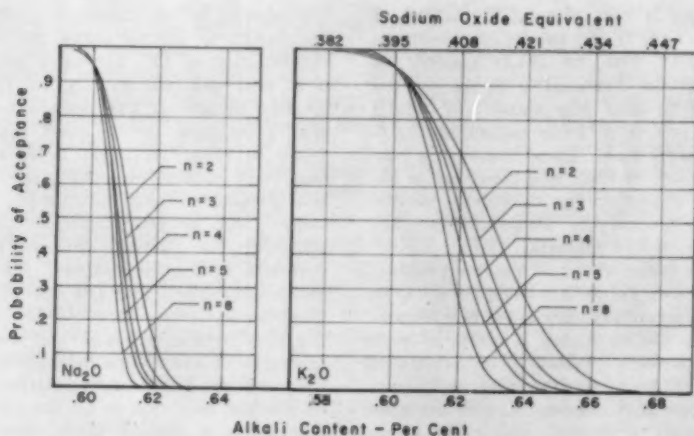


FIG. 2

● PRODUCER'S risk of 10 percent was used to develop the above operating curves for sodium and potassium oxides in Portland cement, using ASTM Methods C114-58T.

be accurately informed on the characteristics of the testing plan used in determining the alkali content of the cement because these characteristics will to an appreciable extent decide whether or not the consumer actually gets low alkali cement and also what the producer's manufacturing costs will be.

We may now examine a tentative testing plan in which we, as consumer, propose to grant the producer a 5 percent risk and to make two tests for  $\text{Na}_2\text{O}$  on each sample of his product. Our principal interest now is in finding out the risks that we will take if the plan is put into operation or, in other words, what is the probability that we will accept a cement with an  $\text{Na}_2\text{O}$  content that is actually greater than, say 0.60 percent. We propose to perform two tests as a minimum because the information provided by one test is meager and nearly useless.

Our first task is to compute the acceptance limit of the plan which will guarantee the producer a risk of rejection of only 5 percent. According to the plan it must be the average of two independent tests for  $\text{Na}_2\text{O}$  on a sample. The computed value turns out to be 0.6116 percent of  $\text{Na}_2\text{O}$  and if in any case the average of the two determinations is not larger than this figure, we agree to accept the shipment of cement represented by the sample.

There is, however, a risk that if we do this we might erroneously accept a shipment of cement with more than the specified 0.60 percent of  $\text{Na}_2\text{O}$ . Figure 1 ( $\text{Na}_2\text{O}$ ) shows the OC curves for plans consisting of 2, 3, 4, 5, and 8 replicate tests for a producers risk of 5 percent.

The curve marked  $n = 2$  in Figure 1 ( $\text{Na}_2\text{O}$ ) shows that if the actual amount of  $\text{Na}_2\text{O}$  in the cement is 0.600 percent, and the consumer performs two independent tests as described above, the probability of the cement being rejected on account of the imperfections of the test method, is only 0.05, 5 percent, or one chance in twenty. This probability of 0.05 is the producer's risk and this risk was intentionally built into the plan when the acceptance limit of 0.6116 percent and the number of independent tests (two) was specified. Since there is a risk of 5 percent that a cement with exactly 0.600 percent of  $\text{Na}_2\text{O}$  will be rejected, it is plain that the probability of its acceptance is 95 percent. (It should be remembered that an  $\text{Na}_2\text{O}$  content of 0.600 percent is satisfactory to the consumer).

Referring again to curve  $n = 2$ , it is seen that if the producer should

submit a cement having 0.605 percent  $\text{Na}_2\text{O}$ , there is a probability of about 82 percent that it will be accepted and if the actual  $\text{Na}_2\text{O}$  content is 0.610 percent the probability of acceptance is still about 59 percent. These probabilities of 0.82 and 0.59 are the consumer's risks and, if for example the consumer did not wish to accept a cement with as high a content of  $\text{Na}_2\text{O}$  as 0.610 percent, the probability of his doing so under the plan is nevertheless 0.59, or about six times as large as a reasonable consumer's risk of 0.10.

Since a good many engineers and concrete experts consider 0.600 percent of alkali as a very definite upper limit, it is apparent that the  $n = 2$  plan gives very little protection to the consumer.

There are two ways in which this risk may be reduced: 1) By improving the precision of the test method and 2) by performing a larger number of replicate tests.

Assuming that the precision of the test method cannot be improved, we may design another plan with the same producers risk, but which will specify eight independent tests, or  $n = 8$ .

The acceptance limit in this case is computed as 0.6058 percent  $\text{Na}_2\text{O}$  or, in other words, if the average value of all eight tests is 0.6058 percent  $\text{Na}_2\text{O}$  or less, the cement will be accepted.

Referring to curve  $n = 8$  in Figure 1 ( $\text{Na}_2\text{O}$ ), we see again that if the producer submits a cement with an  $\text{Na}_2\text{O}$  content of exactly 0.600 percent, his risk of rejection is still only 0.05 or 5 percent. It is also seen in this same curve, however, that if the producer submits a cement with an  $\text{Na}_2\text{O}$  content of 0.605, the probability of its acceptance by the consumer is now about 0.61 instead of 0.82 and, if the producer submits a cement with an  $\text{Na}_2\text{O}$  content of 0.610, the probability of its acceptance is now only about 0.11, which is very close to a reasonable consumer's risk. Thus increasing the number of tests will compensate for the imperfections of a test method and reduce the probability of accepting bad material.

In other words, if a cement manufacturer submits a product with an  $\text{Na}_2\text{O}$  content very close to 0.60 percent, the consumer is going to have to perform at least 7 or 8 tests in order to guarantee that both producer and consumer will be adequately protected. The exact number of tests will depend upon how much  $\text{Na}_2\text{O}$  the consumer is willing to tolerate and the magnitude of the producer's and consumer's risks. The

effect of the precision of the test method is also brought out by comparing the spread of the family of curves for  $\text{K}_2\text{O}$  with the spread of the family of curves for  $\text{Na}_2\text{O}$ . It will be recalled that the precision of the test for  $\text{K}_2\text{O}$  is 0.025 as compared with the precision of 0.010 for  $\text{Na}_2\text{O}$ .

The OC curves in Figures 1 and 2 are for what the statisticians and quality control engineers call single-sided or single-tail plans. These single-sided curves are used in the present example because the consumer of low alkali cement is only concerned with some stated maximum amount of alkali in the product, usually 0.60 percent. The figures along the abscissas in the drawings might also be expressed as fractions of the precision of the test.

### Producer and Consumer As Single Individual

The terms "producer" and "consumer" seem to imply two individuals or organizations which is not necessarily true in all cases. For example, the cement manufacturer's chemist may be thought of as both producer and consumer inasmuch as he must or should be able to lay out a control testing plan which will give him, at a reasonable cost, a definite degree of protection against producing bad material. In order to devise a rational plan of this kind, he must be able to compute the OC curves for various testing plans in order to select the one most suitable for the purpose. Unless this is done, all control testing plans (as well as acceptance testing plans) will remain as they are now—empirical and inferior substitutes for what could and should be rational and scientific procedures.

It should be mentioned now that the design of testing plans and the construction of OC curves is not a new and untried novelty or far-fetched theory. It has been a routine procedure for a good many years in other technical fields but has been completely neglected by the producers and consumers of cement and by the committees responsible for Portland cement test methods and specifications. All of the testing plans and the specifications now in use are merely reflections of the opinions and compromises of committee membership; they are not based on the attributes of the test methods or on the characteristics of testing plans derived from the precision of the test methods. It is hoped that this paper will be helpful in placing both of them on a sounder scientific basis.

# BASIC PRINCIPLES OF PAVEMENT DESIGN

E. J. YODER

Associate Professor  
of Highway Engineering  
and Research Engineer,  
Joint Highway Research Project,  
Purdue University

**T**HE STRUCTURAL DESIGN of pavements has received a great deal of attention in recent years by designers and researchers alike. Design concepts applied to bridges and buildings include, as a rule, specifications relative to allowable strength. Detailed analytical analysis then permits a rigorous solution of stresses. Thus, the engineer can equate (within certain limits) allowable and actual stresses to proportion the structural members.

These concepts, however, cannot at the present time be applied, per se, to structural design of pavements for a number of reasons. First, the ultimate support of all pavements is derived from the subgrade where the complexities of soil behavior require that certain simplifying assumptions be made at the outset. Second, pavements are layered systems which depart radically from the usual assumptions of homogeneity. This is further compounded by the fact that pavement behavior under load is influenced not only by the properties of individual layers, but also by the interaction of the properties of the various layers as well.

A third point which complicates the problem of design is that loads which are applied to a pavement are transient (and in addition these loads are repeated many times). Position of load on the pavement, geometric design, vertical position, and seasonal and daily climatic variations also have pronounced effect on pavement performance.

Pavements (and highway pavements in particular) are, as a rule, public facilities financed by tax dollars. This places an additional encumbrance on the engineer—and perhaps justifiably so. Every highway user has his own opinion as to the suitability of the highway and very often considers himself to be an expert in matters pertaining to highway design.

Opinions of road users and engineers as to acceptable structural performance are largely subjective. These opinions are influenced by such things as driver reaction, comfort, safety, convenience, economics, prejudices and many others.

As a result of these manifold problems, engineers have evolved arbitrary sets of rules which can be used as guides in design and often times are used to establish final design itself. To illustrate, consider the history of pavement design. During the early stages of development, engineers relied almost entirely upon rule-of-thumb techniques. Later, the advent of the science of soil mechanics brought about new concepts which could be applied to pavement design. Correlations indicated

At this vital period in our roadbuilding history, with the joint efforts of Federal and State talents and money providing the greatest highway construction program of all time, the design of pavements assumes special importance in engineering science and economics. In the discussion to follow, Part I (appearing in this issue) deals with general matters of performance, traffic and environmental considerations. Part II and Part III (scheduled for subsequent issues) will consider the design of rigid and flexible pavements.

the effect of soil type on pavement performance. Frost action and adverse drainage conditions were recognized early as two of the primary causes of pavement failure. Nevertheless, many times the design consisted of using standard sections.

The Bureau of Public Roads and Corps of Engineers recognized at an early date the need for a more rational approach. Research by these organizations, the Department of the Navy, universities, the Federal Aviation Agency and many highway departments advanced design concepts a marked degree. Many test pavements were built; some were exposed to normal traffic, others were tested utilizing accelerated traffic.

The net result has been that present day design concepts are in part both empirical and theoretical. Many design "methods" are available. Sometimes thickness and quality of pavement for a given set of conditions, determined by several of the methods, show wide discrepancy. This has been caused principally by the opinion aspect mentioned earlier.

Pavement design should embody two broad aspects: 1) Evaluation of pavement performance and establishment of criteria to fit a given set of conditions (economic and socialistic factors considered) and 2) a thorough understanding of the basic principles of pavement behavior under load so that a structure can be designed to fulfill the first item.

In the discussion to follow, of necessity, many of the factors will be oversimplified. Detailed techniques will not be considered, but examples of current design methods will be presented to illustrate design concepts. The overshadowing factors of functional and structural performance will be pointed out as the need arises.

*The material in this series of articles is based in part on the book by the author,  
Principles of Pavement Design, published by John Wiley and Sons, Inc., New York, 1959.*



# Part 1—PAVEMENT BEHAVIOR

**T**HERE ARE many factors which must be considered in the design of a pavement. Basically, two broad design problems are considered. The first of these is the design of paving mixtures and quality design of the various pavement components. The second is design of the structure. Obviously, the adequacy of the second phase is dependent on the adequacy of the first.

Structural design of pavements is different from the structural design of bridges and buildings in that it is not possible to specify within reasonably close limits allowable stresses. Quality variation exists in most engineering materials but the variation in soil types encountered along the right-of-way of a highway may be between extreme limits. Soil strength depends upon many factors including: 1) Density, 2) moisture content, 3) soil texture, 4) rate of loading, and many others. Laboratory tests on subgrade soils are made on small samples which approximate the anticipated condition in the prototype pavement. In addition, most methods of design are either empirical or semi-empirical and are based upon correlations with field performance. As a result, it is necessary to make arbitrary assumptions regarding design test data. For example, when designing flexible pavements by the California Bearing Ratio method, samples of soil are compacted in a standard manner and then permitted to soak in water for a period of four days. The soaking period simulates subgrade saturation due to high water table and precipitation. Thus the design test is made when the soil is in its weakest condition.

A fundamental assumption is made that the conditions of testing imposed in the laboratory simulate the actual environmental and loading conditions that will exist on the prototype pavement; therefore it is essential that construction procedures be such that these basic design assumptions are valid.

Factors which must be considered in the design phase are traffic, climate, geometry, position, and construction and maintenance practices. Total load influences thickness requirements for flexible pavements. Tire pressures do not control the thickness of a flexible pavement to

any great extent, but they influence the required quality of surface and base appreciably. Total load also influences the thickness of rigid pavements; tire pressures affect the thickness of rigid pavement to a lesser extent.

Repetition of load has a direct influence on both types of pavement; for higher repetitions of load, heavier pavements are required. Likewise, the geometry of pavement has a direct effect in that, if loads are applied close to the pavement edge, some consideration must be given to increasing the structural capacity of the pavement edge.

Some of the effects of climate are difficult to evaluate. It is possible in most cases to take into account frost action and rainfall but the exact effects of them oftentimes cannot be truly evaluated; climatic conditions must be studied from a statistical standpoint and it is difficult to predict the severity of climatic conditions for the life of the pavement.

Design criteria for rigid pavements are generally based upon allowable tensile stress of the concrete. Granular base courses for control of pumping are generally used at arbitrary depths determined by field performance. Bases for frost action may be used to depths sufficiently great to prevent substantial freezing of the subgrade with loss of subgrade support.

The principles involved in design of a flexible pavement consist of testing or classifying the subgrade soil and then, from correlation data or theory, determining the thickness of pavement required to protect the subgrade. The subbase can also be tested in a similar manner and the thickness of surface and base determined. Through the testing of successive layers, the thickness required of each component is determined.

Regardless of the methodology of testing and design, the objective foremost in the mind of the engineer is to provide a pavement structure which will carry the anticipated traffic with a minimum amount of distress. Ideal solutions which cover a wide variety of conditions rarely exist; each design problem has a unique solution depending upon loading conditions, climate and availability of materials.

An attempt will be made in the following paragraphs to clarify the ramifications of each of these factors which affect design. Since a certain degree of interrelation exists among the factors affecting pavement performance, it will be necessary to make several simplifying assumptions. The discussion will be developed with the endpoint in mind to show why certain factors must be considered and how these can be applied to design problems.

## PAVEMENT TYPES

Through common usage of standard definitions, pavements have been divided into two broad categories, flexible and rigid. The difference between the two types of pavements is highly relative. It is possible for a pavement to possess varying degrees of both flexibility and rigidity.

Sometimes Portland cement, lime or other cementing materials may be used to stabilize a flexible base. If a sufficient quantity of the cement is used to harden a soil, the stabilized soil can probably be termed semi-flexible. On the other hand, if low amounts of stabilizer are used (merely to modify the plas-

ticity of the soil), the stabilized soil cannot be called semi-flexible.

According to the dictionary the word rigid denotes a material which is stiff, unyielding and firm. In contrast a flexible material is defined as one capable of being flexed. Neither rigid nor flexible pavements fit either of these definitions exactly. Nevertheless, through common usage of definitions, rigid pavements are those made from Portland cement concrete whereas flexible pavements are those containing an asphaltic surface and flexible base. For purposes of clarity these definitions will be used throughout the remainder of these articles.



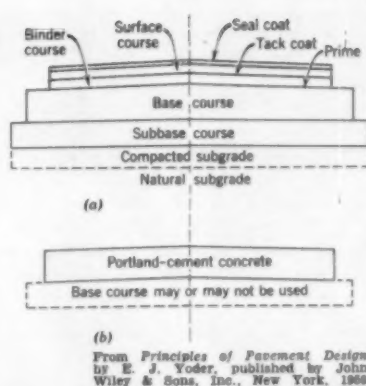
Figure 1 illustrates schematically the components of flexible and rigid pavements. Referring to Figure 1(a) the flexible pavement consists of a bituminous wearing surface built over a base course and subbase course resting upon the compacted subgrade. In contrast, rigid pavements are made up of Portland cement concrete and may or may not have a base course between the pavement and the subgrade. By definition, the flexible pavement includes all components of the pavement exclusive of the compacted subgrade. Thus, the subbase, base and wearing surface are the structural components of the pavement. In the case of the rigid pavement the concrete, exclusive of the base, is generally referred to as the pavement. In some cases Portland cement concrete is used as a base course for a flexible type surface.

The primary difference between the two types of pavements, flexible and rigid, is the manner in which they distribute the load over the subgrade. The rigid pavement, because of its high modulus of elasticity, tends to distribute the load over a relatively wide area of soil, a major portion of the structural capacity being supplied by the slab itself. As a result, a major factor to consider in the design of rigid pavements is the structural strength of the concrete. Minor variations in subgrade strength have little influence upon the structural capacity of the pavement.

The load carrying capacity of flexible pavements is brought about by the load distributing characteristics of the layered system. Flexible pavements consist of a series of layers with the highest quality materials at or near the surface. Hence, the strength of a flexible pavement is a result of building up pavement layers which distribute the load over the subgrade, rather than by the bending action of the slab. The design thickness of the pavement is influenced appreciably by the strength of the subgrade.

Base courses are used under rigid pavements for various reasons including control of pumping, control of frost action, drainage, control of shrink and swell of the subgrade, and expedition of construction. The base course adds some structural capacity to the pavement; however, its contribution to the total load carrying capacity is relatively minor.

It is important to note that the primary function of the granular layer in a flexible pavement is to provide a stress distributing media,



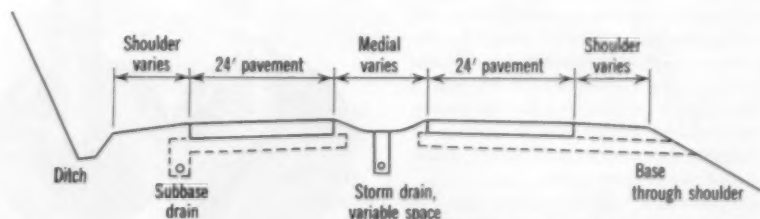
● FIGURE 1. Schematic shows components of (a) flexible and (b) rigid pavements. Base courses under rigid pavements are often called subbases.

whereas the primary purpose of providing bases under rigid pavements is to control pumping, frost action, etc.

### Highway Cross Sections

The standard pavement width for modern highways is generally 24 feet. The shoulders adjacent to the traffic lane are of various widths, usually about ten feet. A typical cross section is shown in Figure 2.

Base courses and subbase courses under highway pavements may be constructed using one of several techniques. If the material is pervious, it may extend through the shoulder to permit drainage at the point of intersection with the side slope. In some cases, particularly in cuts, subbase drains may be used. Many highways are built using trench construction. In this type of construction drainage is not attempted. The choice of method of construction should depend upon the type of base course. Dense graded base courses are nearly impervious; hence, drainage installations are generally not warranted and the materials may be constructed in a trench. Open graded bases, however, should be drained to preclude ponding of water on top of the subgrade.



● FIGURE 2. Cross section of typical four-lane highway with depressed median.

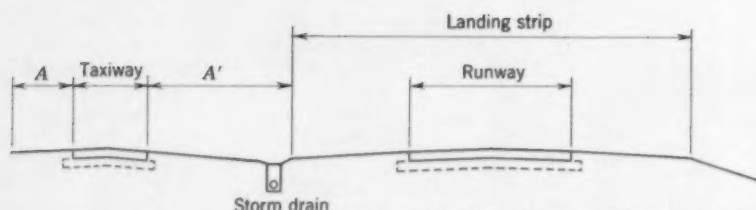
Pavements with thickened edges are used in some situations to accommodate high stresses that exist at the pavement edge. The pavement sections are designated, for example, as 9-8-9 inch, 9-7-9 inch, 9-6-9 inch etc. Thickened edge pavements are more costly than uniform pavements because of the special grading operations that are required at the pavement edge. Thickened edge highway pavements were popular at the time when pavement widths were in the neighborhood of 18 to 20 ft. and traffic traveled very close to the pavement edge. On wider pavements, however, traffic concentration is between three and four feet from the pavement edge alleviating the necessity of using a thickened edge.

### Airport Pavement Cross Section

In contrast to highways, airfield runways are constructed in widths up to 500 ft. The widths of civilian airfield pavements range between 75 and 150 ft. according to the type of airfield. Greater widths are used on some military airfields to accommodate heavy bombers. Runways are nearly always crowned, whereas highway pavements may or may not be crowned. In some cases, it is more economical to build nearly flat highway pavements tilted downward toward the outside lane with no crown. This type of construction, however, is not justified on major airfields because of the long distance the water would travel to drain from one edge of the pavement to the other.

Taxiway widths vary from 40 to 75 ft., depending upon the class of airport. It is seen in Figure 3 that a landing strip is indicated on either side of the runway. The landing strip is not paved, but is a stabilized, graded slope which can be used in case of emergency. Landing strips are generally about 500 ft. wide.

Taxiways and runway ends should always be constructed of a heavier section than the central portion of the runway for several reasons. Touchdown at the end of the run-



From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

● FIGURE 3. Typical runway and taxiway cross section. Variable widths depend on the type of airport. Distances A and A' are determined by clearance standards.

way is not particularly critical because the airplane is partially airborne. Figure 4 shows progressive views of an airplane landing gear during the landing operation. It is noted that at the time of touchdown the shock absorber is extended and that the absorber compresses as the additional load is transferred to the gear.

In contrast to the above, during the initial takeoff operation the airplane is at full load. In addition, high stresses are set up in the

pavement as a result of engine run up. The full-load factor, coupled with the fact that aircrafts move relatively slow on taxiing and at the start of the take-off run, necessitates thickened pavements on the taxiways and runway ends. The length of the thickened section at the end of the runway ranges between 10 percent of the total runway length recommended by the Federal Aviation Agency and 1000 ft. recommended by the Corps of Engineers.

## PAVEMENT DISTRESS

Before consideration can be given to design techniques it is necessary to consider the matter of pavement distress. One of the biggest questions that must be considered is, "What constitutes a failure?" This factor probably affects the variation in design thicknesses obtained by the various methods as much as any other single point. It is the intent here to illustrate various types of pavement distress with the end point that design criteria should be based upon pavement performance.

There is no exact definition in existence at the present time which states the ultimate desired performance of pavements. Engineers vary widely in their concepts of acceptable performance. If one is willing to accept the assumption that the purpose of the pavement is to carry vehicles over it through all weather conditions with maximum comfort and minimum inconvenience to the user, design criteria immediately imply relatively-smooth surfaces, accident-free roads and economic operation of vehicles over the pavement. This leaves the definition of ultimate failure open to the opinion of the pavement user.

Distinction will be made here between two types of failure. The first, structural failure, includes the collapse of the pavement structure or

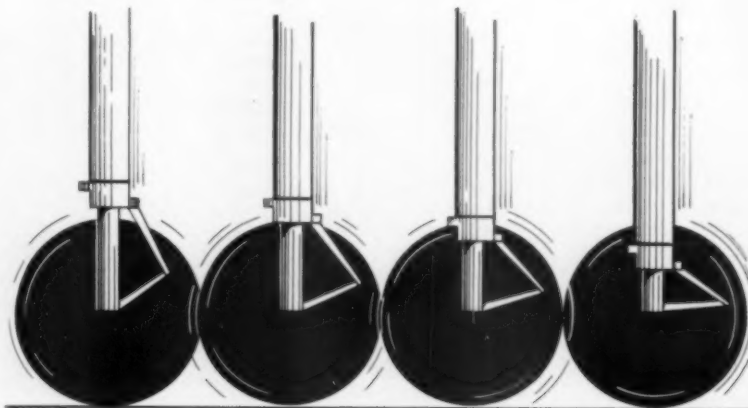
a break down of one or more of the pavement components of such magnitude as to make the pavement incapable of sustaining the loads imposed upon its surface. The second, functional failure, is such that the pavement due to its roughness will not carry out its intended function without causing discomfort to passengers or without causing high stresses in the vehicle which passes over it.

Obviously the degree of distress for both categories is gradational and the severity of distress of any

pavement is largely a matter of opinion of the person observing the distress. However, the difference between the two types of failure is important and the engineer must be able to distinguish between them. As an example, consider a rigid highway pavement that has been resurfaced with an asphaltic overlay. The surface may develop rough spots as a result of breakup in the bituminous overlay (functional failure) without structural breakdown of the overall structure. On the other hand, the same pavement may crack and break up as a result of overload (structural failure). Maintenance measures for the first situation may consist of resurfacing to restore smooth riding qualities of the pavement. However, the structural type of failure may require complete rebuilding.

The difference between functional and structural failure can also be demonstrated by considering airport pavements. The rapid development of jet aircraft in recent years has had a profound effect on pavement design concepts. Historically, design engineers have had uppermost in mind the effect of vehicular traffic upon the pavement. In contrast, present day concepts involve a study of the effect of the pavement upon the aircraft, as well as the effect of the aircraft on the pavement. Jet engines are easily damaged by debris sucked into the air intakes. Thus, much research has gone into the design of shoulders and areas adjacent to runway ends to make them resistant to erosion from jet blast. Also the pavement must be resistant to the effects of fuel spillage and heat.

The bicycle landing gear has resulted in channelized traffic. The ground operation characteristics of the B-47 bomber, for example,



● FIGURE 4. Progressive views show an airplane landing gear during landing.



● FIGURE 5. Transverse cracking in a plain concrete slab with no joints. Matchbook helps judge width of the opening.



● FIGURE 6. Diagonal crack in a concrete slab. In this case primary cause was attributed to an overload of the pavement.

coupled with the bicycle landing gear and channelized traffic have resulted in "porpoising." This phenomena is due to changes in longitudinal grades which cause a plane to undulate. Thus, it is seen that functional failure can precede structural failure.

#### **Rigid Pavement Distress**

Distress of rigid pavements can be due to two basic causes. The first is deterioration or deficiency of the pavement itself. This deterioration might be brought about by freezing and thawing, use of non-durable materials, alkali-aggregate reaction, scaling resulting from use of salts for ice removal and a variety of other causes. Distress of rigid pavements may also result from improper dowel alignment, warping, curling, contraction and expansion stresses.

The other category deals with the structural adequacy of the pavement-base-subgrade structure. Here overload may be evident by pavement pumping and blowing, corner breaks, faulted joints and other defects. When rating pavements, it is necessary to distinguish between these two basic types of distress. Figures 5, 6 and 7 illustrate three defects which can be found on rigid pavements.

If long slabs are built, transverse cracks may result from warping or contraction of the slab. Figure 5

shows a transverse crack in an unjointed pavement. It is to be noted that the crack in the Figure has opened a considerable amount, the average measured width being about one-quarter to one-half inch. The width of the crack can be judged from the match-book cover appearing in the foreground. This particular pavement contains no temperature steel, thus permitting development of wide cracks.

Transverse cracks generally offer no particular problem except as shown in this Figure. For this case no load transfer is provided across the crack. Thus, progressive deterioration due to loads may result. The initial crack at this location was no doubt caused by contraction and/or warping and its development may have been entirely independent of loading conditions. However, since no load transfer is provided across the crack, it may soon progress to structural failure and if faulting takes place, it can soon become a functional failure.

Figure 6 shows a diagonal crack on a concrete slab. In this particular case the primary cause for the formation of the crack is believed to be overload. In some cases, structural breaks are the most difficult to evaluate, particularly if scaling and/or spalling occurs because scaling and spalling obscure the analysis. As a general rule, cracks which occur relatively close to a

joint are probably structural breaks, whereas those occurring in the center of the slab are probably due to warping and/or contraction. However, the statement must be modified upon the basis of known subgrade conditions, type of concrete and aggregate, and conditions.

In Figure 6, faulting of the forward slab is noted and shifting with resulting opening of the crack is apparent. Spalling of the joint due to excessive deflections is noticeable. Structural failure in this case is a result of consolidation of the fine sand subgrade and, due to the fact that the depressed joint has caused a rough surface, it can be stated that both structural and functional failures have occurred. Figure 7 shows a rigid highway pavement in which no load transfer devices were provided at the contraction joints. The slabs are 15 ft. in length. It can be seen that faulting has resulted at nearly every slab and that pumping has been significantly apparent. Faulted joints result in imperfect riding qualities and thus may be considered to be functional distress. From the structural standpoint this pavement is no doubt capable of sustaining the design load and will continue to do so for many years.

Cracking of rigid pavements may or may not represent a failed condition. If the cracking is not progressive, it may not be detrimental and in fact, may be beneficial.





● FIGURE 7. Faulting is due to the lack of load transfer devices at contraction joints. Pumping also is very evident.



● FIGURE 8. Map or alligator cracking in a flexible surface. This sign of pavement distress is attributable to several causes.

Transverse cracks in rigid pavements are detrimental only as long as load transfer is lost. Cracks caused by contraction and warping cause no apparent harm to the pavement so long as load transfer is provided by the grain interlock supplied by the temperature steel.

Rigid pavements will crack if stresses in the slab exceed the modulus of rupture. If non-uniform subgrade support exists, high stress concentrations will nearly always result at certain portions of the slab. However, as soon as a crack forms and the overstressed condition is relieved, the slab may settle a small amount and uniform support may again be realized. Thus, crack counts on rigid pavements are of benefit only as long as interpretation can be placed upon them in regard to load transfer and to whether or not the cracks are of a progressive nature likely to cause further deterioration and ultimately a rough riding surface.

### Flexible Pavement Distress

Structural failures in flexible pavements may result from consolidation or shear (or a combination of these) developing in the subgrade, subbase, base course or surface. In the case of shear failures, upheaval beside the rut is generally noted. In contrast, rutting can be caused by consolidation with no evidence of upheaval near the rutted pavement. Lateral shoving can also cause surface irregularity. Distress may be caused by too little or too great an amount of asphalt or excessive deflection which in turn may result in fatigue of the surface.

One of the first signs of pavement distress is the occurrence of alligator cracks as shown in Figure 8. This type of cracking is also termed map cracking. The condition is indicative of excessive movement of one or more of the underlying layers and/or fatigue of the surface and may or may not be progressive.

Flexible pavements built over resilient subgrades will often exhibit alligator cracking. Weak or improperly compacted base courses can cause this type of surface condition.

At the stage of development shown in Figure 8, the cracking is generally considered to be indicative of a potentially rough riding surface. This could result after repeated application of load has caused chuck holes to develop in the surface. Without the development of chuck holes, functional failure is not apparent, but if chuck holes form, extreme discomfort can be caused to the pavement user.

Figure 9 indicates a subgrade failure and resulting ruts. In this particular case, distress is attributed to underdesign insofar as pavement thickness is concerned. This pavement represents an extreme case of both structural and functional failure.

Figure 10 illustrates longitudinal cracking which can result from a variety of causes, including shrinkage of the subgrade, deep seated consolidation, and others. For the case shown in Figure 10, sharp undulations in the pavement are not apparent. However, the road is depressed at the outside edge due to consolidation of the subgrade. For high-speed highways this type of movement cannot be tolerated; for secondary roadways the condition has no significant effect upon vehicles.

Excessive movement of flexible pavements (which eventually result in uneven riding qualities) may be caused by poor qualities of the subgrade, subbase, base or wearing course. A qualitative measure of the effect of the movement can be determined only after thorough in-



● FIGURE 9. Subgrade failure and ruts due to inadequate pavement thickness.



vestigation. The investigation may take the form of trenching in which visual inspection is made of the cross section of the pavement. Measurements of the thickness of the various paving layers inside and outside the traffic lane can also be made.

Items described in previous paragraphs are but a few of many; each distress must be evaluated to determine whether the distress will be progressive or whether it represents an inactive condition. Deficiencies resulting from flushing or bleeding of bituminous concrete are obvious and have not been discussed but they must be given due consideration, particularly from the standpoint of skidding resistance.

There are many different types of pavement distress (1), each representing a condition unique to that section of pavement. In some cases distress is not attributable to any one particular thing but to a combination of factors. A thorough understanding of the mechanics of behavior is essential before an individual can evaluate the cause of the defect and its possible adverse effects.

#### Techniques of Measuring Defects

Logging of defects on rigid pavements offers no particular problem since it is possible to make a count of the number of cracks occurring per slab or per mile of length. However, it is necessary to determine whether the cracks which appear on the surface are critical or whether they represent static conditions. This can be done with a considerable degree of success by drawing



● FIGURE 10. Longitudinal cracks in flexible surface are accompanied by a depression along the pavement edge.

sketches of the pavement and indicating on the sketch the location, approximate length of the crack and other pertinent information. Recent developments in photography also permit the ready analysis of performance by means of strip photographs of the pavement surface. An example is shown in Figure 11.

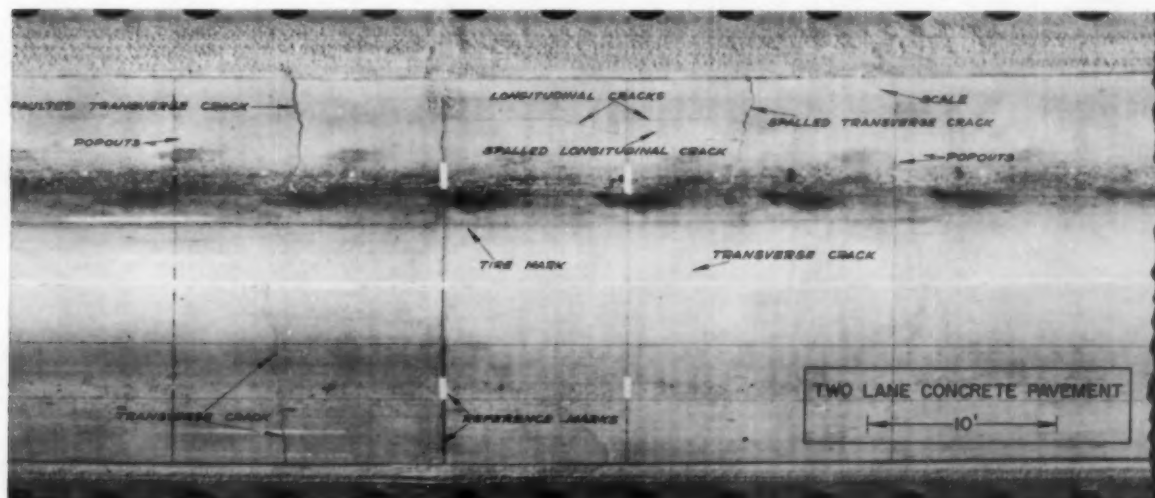
Flexible pavements present a somewhat different situation in that visual determination of the distress cannot be catalogued with a great degree of certainty. Nevertheless, estimates can be made of the percentage of the surface area which is affected.

Several instruments are available which give objective measurements of the condition of the pavement surface. These measurements in turn can be correlated with subjective rating of pavements by field inspection.

Perhaps the most widely used instrument is the common straight edge. This device measures undulations of the pavement surface but is limited by its span length. Accelerometers have been used with some degree of success for determining pavement profile. Since vertical distance obtained by this method is a function of time, small changes in elevation over large longitudinal distances cannot be measured except at high velocities of the measuring vehicle.

Figure 12 shows two Benkelman Beams being used to measure deflections of a flexible pavement between the dual tires of the rear axle of a truck. This device, although used primarily to evaluate structural adequacy of a pavement, also yields much useful information relative to the pavement's serviceability. The instrument has come into widespread use throughout the world in recent years. It enables the rapid determination of pavement deflections at a large number of locations in an economical manner (2).

The Bureau of Public Roads roughometer shown in Figure 13a, is a device which, when towed over a paved surface is assumed to stay in a relatively fixed plane due to its own inertia. Changes in elevation are measured by means of a floating wheel which follows a paved surface and deviates from the machine proper.



● FIGURE 11. This unretouched photo (except for notations) shows an enlarged portion of a test survey film record.

Courtesy: Arco Service Corporation



● FIGURE 12. Using Benkelman Beams to determine the deflection of a flexible pavement. Measurement is made between the dual tires of the heavily loaded truck.

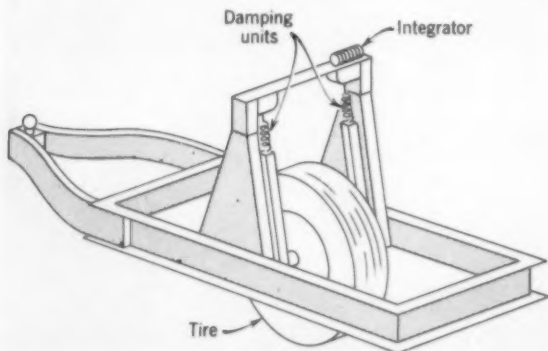
The device consists of a rectangular frame, inside of which is a single wheel equipped with a pneumatic tire which has its axle attached to the center of two single leaf springs, one on each side of the wheel. The integrator unit is mounted on the cross frame over the wheel; the pistons of two dash-pot spring damping devices are also attached to the cross piece.

Values of pavement roughness as obtained by the device are relative and, therefore, it is necessary to correlate the values with known surface behavior. Pavements showing roughness values of less than 60 inches per mile can be considered to be excellent. Roughness indices greater than 150 inches per mile indicate a very poor riding surface.

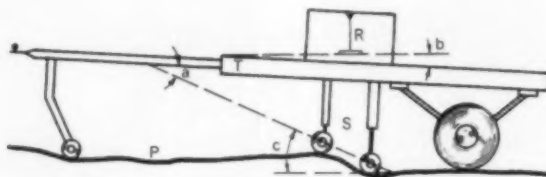
Roughometer data, however, are quite variable and may give high indices even for new pavements. This observation indicates the important principle that performance surveys should be of a continuing

nature and should be made periodically as the age of the pavement progresses so that misleading "one-shot" results may be avoided.

Figure 13b shows a schematic diagram of a profilometer. Instruments such as this, utilizing gyroscopes or pendulums which measure the angle of inclination with respect to a fixed vertical plane, offer great possibilities for measuring pavement profiles and surface irregularities. In this instrument the pendulum measures the angle between the frame of the vehicle and an imaginary horizontal or vertical plane. Feeler wheels then measure the angle between the pavement profile at a given point and the frame of the vehicle. From these data the true profile and slope of the pavement can be determined. The principle of this instrument has been used for terrain measurements and has been developed with a high degree of success by the AASHO Road Test personnel for evaluation of pavements (3).



From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959



● FIGURE 13b (above). A schematic diagram of the AASHO road test profilometer. Angles "a" and "b" are measured by slope assembly S and reference R respectively. The angle "c" between pavement P and horizontal is the sum of "a" and "b".

● FIGURE 13a (left). Bureau of Public Roads Roughometer.

### Serviceability Concept

In connection with evaluation of the pavements at the AASHO Road Test, a system of rating pavements was devised which relates subjective rating and objective measurements. Recognizing that opinion plays an important role in pavement evaluation, personnel of the road test set up a panel rating system in which pavement evaluation made by a group of individuals is analyzed in light of physical measurements such as pavement profiles, extent of patching, etc.

Briefly stated the method of approach is as follows. A rating panel is set up to evaluate the pavements. The members of the panel are taken in small groups to the pavements to be rated. They are permitted to ride over the sections in automobiles of their choice and to walk over the pavement if they wish. Each panel member then rates the pavement and places his rating on a card. Discussion among the panel members during the rating period is not permitted.

This phase of the rating in itself gives an answer to the question of pavement serviceability. If the panel members could inspect the pavement often enough, objective measurements (surface deformation, etc.) would not need to be made. However, to minimize the need for using a panel for continuous ratings, physical measurements can be correlated with the subjective rating. Measurements adopted at the road test were of two categories: Those which defined surface deformation and those which described surface deterioration.

Pavement rating such as that described above permits several end-points to be accomplished. First, the rating (and/or objective measurement) can be used to set up priority of construction and maintenance.

Second, by making surveys throughout the life of the pavement, a means of comparing performance of several pavements is offered. Third,

and perhaps most important, use of a number to define pavement performance in design equations is possible.

## TRAFFIC ANALYSES AND EFFECTS

Airplane and truck wheel arrangements can be divided into several basic categories including: 1) Single and dual wheels, 2) single and tandem axles, and 3) tail wheel, tricycle and bicycle landing gear. Airplane wheels may be arranged in several combinations of those listed above. Large aircraft utilize either the tricycle or bicycle landing gears. In the case of tricycle landing gears, the main gear load can be of single, dual or dual tandem type (Figure 14). Bicycle landing gears may be used on heavy jet aircraft as shown in Figure 14(d). Two small wheels are utilized near the ends of the wings for ground stability.

In the design of airfield pavements, the design gear load is that of the heaviest plane which will utilize the field. Civilian airfields are designed according to the Federal Aviation Agency classification system. The airport is first classified according to its anticipated traffic which in turn dictates the length of the runways, width of the runways, taxiways and landing strips as well as the maximum grades that are permitted. The design wheel load is the single wheel indicated in the last column of Table 1.

Table 2 presents design data for several types of aircraft. It will be

noted that tire pressures range from as low as 45 psi to over 200 psi. Likewise, the gear loads in this Table range between about 8000 pounds and more than 200,000 pounds.

Allowable axle and wheel loads for highways vary from state to state as indicated in Table 3. The majority of the states permit single axle loads of 18,000 pounds and maximum tandem-axle loads of 32,000 pounds. Tandem spacings

range between 36 inches and 48 inches. Tire pressures are controlled generally by allowable load per inch of width of tire. Some states have more than one specification of allowable load per axle depending upon whether pneumatic tires or hard tires are used. This accounts for the high sum of the number of states in the right-hand column of Table 3.

Of necessity, design formulas for design of pavements are applicable to static loads but not necessarily to transient loads. Present day trends toward heavier wheel loads coupled with increased repetition of loads necessitate a detailed study of the relative effects of these factors.

### Transient Versus Static Loads

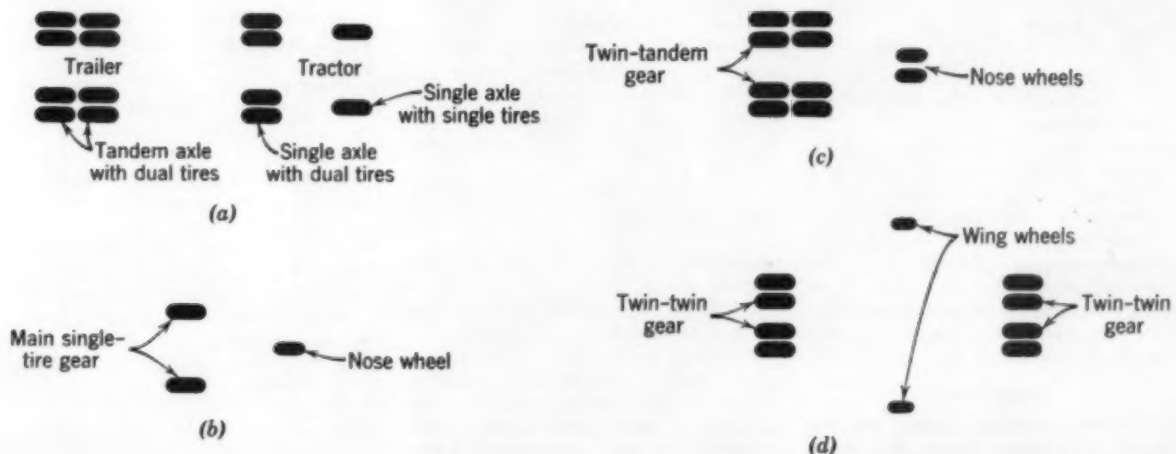
The stress strain characteristics of paving materials vary with the rate

Table 1. Airport Design Standards

Air Carrier Service(a)	Runway Length	Runway Width	Taxiway Width	Landing Strip Width	Maximum Grades			Equivalent Single Wheel
					Eff.(b)	Long.	Trans.	
	(ft)	(ft)	(ft)	(ft)	%	%	%	(1000 lb)
Secondary	1600 to 3000	75	40	250	1½	2	2	
Local	4200	100	50	400	1	1½	1½	30
Trunk	6000	150	75	500	1	1½	1½	60
Continental	7500	150	75	500	1	1½	1½	75
Intercontinental	10500	150	75	500	1	1½	1½	100

(a) Air carrier service is defined as follows: Secondary—small private airports; Local—airports to serve local service routes with hauls normally not exceeding 500 miles; Trunk—airports to serve routes with intermediate hauls normally not exceeding 1000 miles; Continental—airports serving long nonstop flights up to 2000 miles; and Intercontinental—airports to serve the longest range nonstop flights in the transcontinental, transoceanic, and intercontinental categories.

(b) Effective gradient is obtained by dividing the maximum difference in runway center-line elevation by the total length of the runway.



From Principles of Pavement Design by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

● FIGURE 14. Plan view of several types of wheel configurations for truck and aircraft. [Note: Not to scale.]



Table 2. Aircraft Data

Type of Plane	Tread	Wheel Base	Type Gear	Gear Load (lb)	Tire Pressure (psi)	Contact Area (sq. in.)
DC 3	18' 6"	37' 9"	Single	11,800	45	238
Martin 404	25'	22' 4"	Dual 23 3/4"	21,000	62	170
Convair 340	25'	26' 2"	Dual 24 3/4"	21,306	69	152
DC 7	24' 8"	36' 2"	Dual 30 3/4"	58,100	123	214
Super Constell.	28'	43' 7"	Dual 28"	62,000	120	245
F-86 E	8' 4"	14'	Single	7,873	156	53.5
C-124-A	34' 2"	29' 9"	Dual 44"	99,750	78	585
B-47-B		36' 2"	Dual 37"	95,800	189	267
B-36-D	46'	64'	Dual 31 1/4"	178,000	176	267
			Tandem 61 1/4"			
B-52		49' 9"	Twin-twin	240,000	260	
Boeing 707 Jet			Twin-tandem	122,500		

of load application. This has been illustrated repeatedly on highways constructed on relatively steep grades. Up-hill traffic lanes generally show more distress than down-hill traffic lanes. The difference can be attributed, in part at least, to the speed of the vehicles. The amount a pavement deflects under load depends upon its modulus of elasticity which in turn is influenced by rate of load application. Research data have indicated increases in modulus of elasticity from static to transient loads of as much as 100 to 200 percent.

Rate of loading affects different materials in a variety of ways. In general, the compressive strength of a material tested rapidly is higher than the value determined by a static test.

The rate of increase of modulus of deformation (elasticity) of soil is a function of moisture content and density. Soils compacted at or below optimum moisture or to relatively high densities show high increases; those compacted at moisture contents above optimum or to low densities show lesser increases in modulus of deformation.

Test data obtained on the WASHO and Maryland Test Roads indicate that measured stresses and deflections decrease with increasing speeds (4). Speeds used in these studies ranged between zero and forty miles per hour. More recent data have indicated that curves which relate decrease in deflection with increase of speed tend to bend upward at speeds greater than 40 or 50 mph because of vibrations that are set up by the truck as it moves at the faster speed.

#### Edge Loads

Pavement stress under moving loads is greatest when the loads travel close to the pavement edge. Distribution of vehicles over a highway pavement is determined

primarily by the width of the pavement. Traffic is highly channelized on highway pavements at a distance of 2 to 3 feet from the edge depending upon the pavement width. Passing lanes receive much less traffic than traffic lanes. The position of traffic on airfield pavements depends upon the functional use of the pavement. On runways, the center one-third of the paved area is principally used; on taxiways, traffic is concentrated in the center of the pavement.

#### Repeated Loads

Most design procedures rely upon some type of static load test to determine the resistance of the pavement to movement. Deflection is often used as a criterion for design. It is known, however, that the pavements subjected to repeated loads will show both plastic and elastic deformation and that the relative magnitude of each depends upon the number of load applications. Even though the deformation of a subgrade may be small, accumulated plastic deformations may be of such magnitude as to cause pavement failure. Accumulated deformation of the subgrade is particularly significant for rigid pavements, since the theoretical stress analysis is predicated on the assumption that the pavement is in full and continuous contact.

Laboratory studies on pavement materials have indicated that structural breakdown under repeated loads is in some cases the primary factor which limits the life of a pavement. The initial deformations which cause this type of failure may in some cases be elastic. The behavior of most materials under repeated loads is extremely complex. The matter is further complicated when considering the pavement base course structure. For example, deformations in rigid pavements may be entirely elastic but the deforma-

tion of the subgrade may be both plastic and elastic. Failure of a rigid pavement under repeated load applications can therefore, result from fatigue of concrete, excessive accumulated deformation of the subgrade or a combination of these.

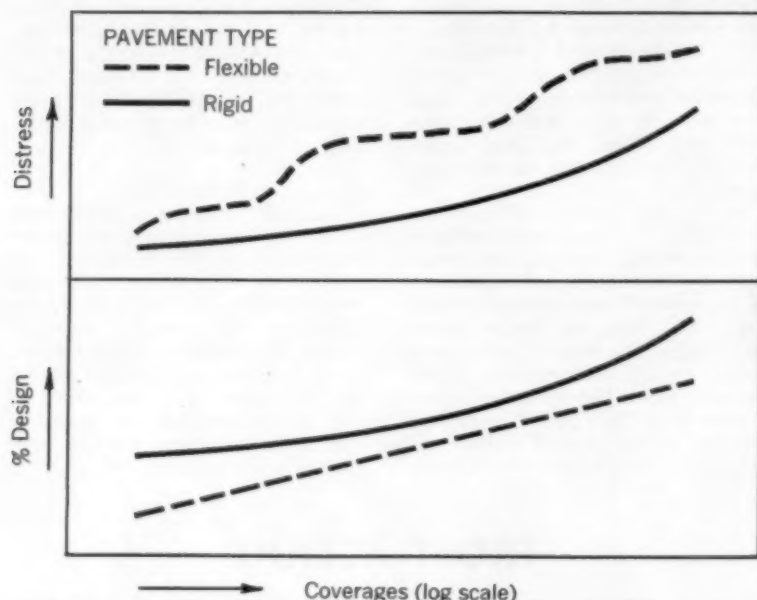
Because of the complexity of the problem, the effects of repeated loads on pavement performance have been widely studied on prototype pavements rather than in the laboratory. A factor which complicates the analysis of field data is that of mixed traffic. It is necessary to assume that wheel loads in mixed traffic act independently of each other. In addition, the interaction of the behavior of the components of the pavement necessitates a qualitative approach. Nevertheless, it is necessary for the engineer to understand the basic behavior of each paving layer so that a better understanding of the relative effects of each can be known.

Concrete exhibits the property of fatigue. A concrete slab subjected to repeated flexure will resist failure until its endurance limit is reached. At this point it will rupture. It is commonly assumed that plain concrete can be subjected to flexural

Table 3. Summary of Truck Axle Weight Limits

Load Per Axle (1000 lbs.)	Number of States
10.8	1
12	1
13.5	1
16	9
17	1
18	31
19	1
21.6	1
22	2
22.4	8
Load on Tandem Axles 4 ft. Apart (1000 lbs.)	
24	1
26	1
28.6	1
30	1
32	27
33	1
34.3	1
36	9
38	2
40	2
40.6	1
Minimum Tandem Axle Spacing (inches)	
36	1
40	33
42	4
46	1
48	3
Not Specified	6





● FIGURE 15. Hypothetical relationship of coverages with distress and percent of design. No scale is used and comparison between pavement types is not intended.

stress almost indefinitely as long as the extreme fiber stress is less than about 50 percent of the modulus of rupture. However the stress which causes failure actually bears a lineal relationship with the logarithm of the number of load applications.

Bituminous concrete may also fail by fatigue. Alligator cracks in asphaltic concrete surfaces may result from repeated load application. This material also shows a lineal relationship between distress and the log of repetition.

In connection with base course materials, three principal effects of repeated loads are recognized. First, some aggregates break down when subjected to high repeated stress conditions. Second, subgrade intrusion into the base course is greatly affected by the number of load applications. Third, blowing of base course materials (pumping) is a function of the number of load applications.

Repeated loads affect soils in a variety of ways including excessive plastic deformations. Tests have shown that the modulus of deformation of a silty clay specimen is higher after repeated loading than that of a duplicate sample which is tested with just one load application. The difference can be presumed to be due in part to densification during loading. In general, the amount of deformation under repeated loads varies directly with the logarithm of the applications.

Considering next prototype pavements, distress of rigid pavements

under repeated loads will manifest itself in several ways. If concrete highway pavements are constructed directly on plastic subgrade materials, high repetitions of heavy axle loads will nearly always result in pavement pumping. The upper portion of Figure 15 indicates the general relationship between distress of the rigid pavement and coverages (5). Roughness of concrete pavements in general bears a relationship with repetition of load similar to that shown on the upper portion of Figure 15. Roughness data depend, however, upon the original condition of the pavement as well as upon traffic. Therefore, many discrepancies are noted and the data obtained are somewhat inconsistent.

Correlation of traffic data with performance of rigid pavements is greatly influenced by daily temperature fluctuations. If traffic is applied during the early morning hours when the slabs are warped upwards at the corners, only a small number of applications of load may cause serious pavement distress.

Data obtained on the WASHO Test Road indicate that repetition of load had a great effect upon flexible pavement distress. However, it was found that structural distress of the pavement was confined largely to two critical periods when the subsurface soils were weakened during early spring thaw. During the first spring, 20 percent of the total distress developed under only 0.7 percent of the total test load

applications and in the second spring period 40 percent of the total distress developed under 13 percent of the load applications. During the summer months only 1.6 percent of the distress occurred under 45 percent of the total load applications.

Seasonal variations have a great influence on the behavior of pavements. This is illustrated in Figure 15 when considering distress of flexible pavements as a function of number of coverages of loads.

Another factor which must be considered is that which relates coverages and number of load applications. Traffic distribution across an airfield pavement is very important. The factor most widely used by design engineers for conventional runways and taxiways considers that 75 percent of the tire tracks of each gear will be uniformly distributed over a 25-ft. width at the center line of the runway and over a 12.5-ft. width of the taxiway. However, recent studies have shown that as much as 75 percent of heavy jet aircraft may travel within a strip 7.5 ft. in width on a taxiway (6). Channelization of aircraft over narrow widths is a result in part of steerable landing gear which permit the pilot to operate the airplane within narrow limits during the taxiing operation. Different aircraft produce coverages at different rates when related to traffic cycles, depending upon the number and size of tires and upon the particular landing gear configuration. For example, aircraft having single tires will produce coverages at one half the rate of those having dual tires of identical width.

Since one coverage occurs when each point in a pavement traffic area has been traversed one time by a tire, it is necessary to assume in the case of dual tandems that a tandem gear will result in twice the coverages of a dual gear. However, this is not strictly correct; in one case the rear dual of the tandem gear tracks immediately behind the forward gear, whereas for the dual gear alone tracking will not result and distribution of coverages will vary across the traffic lane.

Since pavement performance under repeated moving loads varies as the logarithm of the number of load applications (coverages), the concepts can be used for design purposes in a variety of ways. First, the logarithm of the number of stress repetitions (designated traffic index) can be introduced directly into a design formula or second, the repetition concept can be used to determine the percent

design required for repetition less than the design value.

The lower half of Figure 15 shows the general relationship of percent design with coverages. Data of this nature have been used by the Corps of Engineers for design of airfield pavements. Assuming that 5,000 coverages require 100 percent design, the Corps of Engineers state that 10 coverages over a rigid pavement require 80 percent design for initial failure and 10 coverages over a flexible pavement requires about 35 percent design. As a result of the above, considerable reduction in pavement thickness can be realized when anticipated traffic on the airfield is relatively low, the importance of the concepts involved are of such magnitude that they should be thoroughly understood by the design engineer to enable him to make the best use of construction materials in an economical manner.

#### Equivalent Wheel Loads

To utilize repetition of load for design of highway pavements, it is necessary to make traffic surveys and to extend the data into future years. Estimates can then be made of the number of stress repetitions which will be applied during the life of the pavement. However, since traffic on a highway is mixed (that is, has various weights and axle configurations), it is necessary either to assume a governing wheel load or to convert the various loads to some constant equivalent wheel load. Equivalent wheel loads are defined as those which would require identical thickness and quality of pavement taking into account the repetitions of each load. For example, if the pavement will support just 105,000 repetitions of a 5,000 pound load without failure, and if the same pavement will support just 3,000 repetitions of a 10,000 pound load without failure, the two loads and repetitions are said to be equivalent.

Equivalent wheel load factors which have been in common usage

**Table 4. Equivalent Wheel-Load Factors**

Wheel Load (lb)	Factor
5,000	1
6,000	2
7,000	4
8,000	8
9,000	16
10,000	32
11,000	64
12,000	128
13,000	256

for design of highway pavements are shown in Table 4. The data in Table 4 indicate that a 6,000 pound wheel load is twice as destructive as a 5,000 pound load, a 9,000 pound load is 16 times as destructive as a 5,000 pound load, etc. Data shown in Table 4 are used in the following manner.

First, traffic counts are made and the number of anticipated axles in various weight groups are determined. The number of repetitions of these various axle groups are next multiplied times the factor shown in Table 4. The sum of these products (for all the various weight groups) yields the equivalent repetitions of a 5,000 pound load. This number, then, extended through the life of the pavement is the number

In its broadest sense frost action includes both frost heave and loss of subgrade support during the frost-melt period. As a general rule the term "frost action" is a collective one and when used by highway and airport engineers includes all of the effects of freezing temperatures upon pavement performance.

The structural damage of pavements during the spring thaw may result in very high maintenance costs and in some cases, may be of such magnitude as to require posting the road and prohibiting heavy loads during the critical period. The economic loss to the public resulting from the shut down of certain roads may be very high.

#### Frost Heave

The mechanics of the frost heaving phenomenon are extremely complex and include many factors. These factors are: 1) Frost susceptible soil, 2) slowly depressed air temperatures and 3) a supply of water. A true frost heave will not result if any of the above factors are absent.

When water freezes it expands about 9 per cent of its original volume. Therefore, expansion of the soil water during freezing is not enough by itself to account for heaving of several inches to several feet. The mechanics of frost heaving can be visualized as follows. If heat is gradually removed from the soil, water in the pore spaces will cool until freezing takes place. In some cases the water may become super cooled and remain in a liquid state at temperatures well below the

of equivalent 5,000 pound loads that can be expected on this pavement. Application of this analysis to the design of both flexible and rigid pavements will be discussed in the second and third installments of this series of articles.

#### Subgrades

Subgrade type has a pronounced effect on pavement performance and the subject of Soil Mechanics has received wide attention in recent years. Detailed principles of soil engineering will not be discussed herein; the reader is referred to the many textbooks and articles written on this subject (7). The effect of soils on performance and design of subgrades, however, will be discussed in Parts II and III.

## FROST ACTION

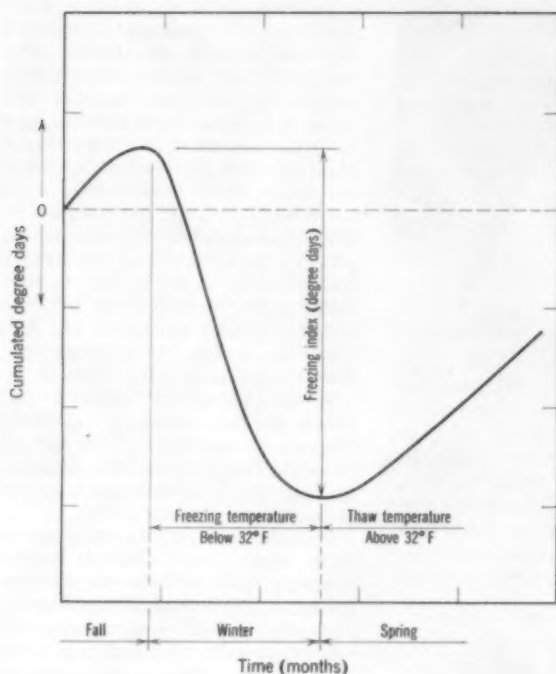
freezing temperature of water (32°F). Next, the super cooled water and ice will have a strong affinity, with the result that water is drawn to the ice crystals that are initially formed. In addition, if the soil is highly susceptible to capillary action, ice crystals will continue to grow until ice lenses begin to form. The lenses in turn will grow until frost heaving results.

Results of studies made by the Corps of Engineers (8), have indicated that frost susceptible soils include all inorganic soils which contain greater than 3 percent by weight finer than 0.02 mm. Frost

**Table 5. Frost Susceptible Soils\***

Group	Description
F1	Gravelly soils containing between 3 and 20 percent finer than 0.02 mm by weight
F2	Sands containing between 3 and 15 percent finer than 0.02 mm by weight
F3	(a) Gravelly soils containing more than 20 percent finer than 0.02 mm by weight and sands, except fine silty sands, containing more than 15 percent finer than 0.02 mm by weight. (b) Clays with plasticity indices of more than 12, except (c) Varved clays existing with uniform conditions.
F4	(a) All silts including sandy silts. (b) Fine silty sands containing more than 15 percent finer than 0.02 mm by weight. (c) Lean clays with plasticity indices of less than 12. (d) Varved clays with non-uniform subgrade

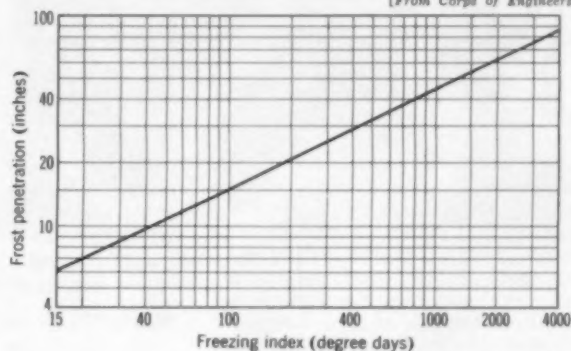
\*From Corps of Engineers



● FIGURE 16a (left). Freezing index is the difference between maximum and minimum points on a cumulative plot of degree days. The plot can start on any convenient date since the data are accumulated. Negative values, where the mean temperature is below freezing, give downward slope to plot.

● FIGURE 16b (below). Freezing index and frost penetration in a well-drained, non-frost susceptible base course.

[From Corps of Engineers]



From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1969

susceptible soils have further been placed into several categories that vary according to degree of frost susceptibility (Table 5). The susceptibility of soils to frost action increase as the frost numbers in Table 5 increase.

In most analyses, frost action is correlated with air temperature. This is a convenient method of analysis since air temperatures are readily available at most locations. Heat transferred from the soil to the atmosphere must pass through the pavement. The effect of type of ground cover with regard to both quantity and color has been known for some time. Frost penetration is deeper and its disappearance faster under bare ground than under grass cover since grass acts as an insulating layer to the soil. Unless the air temperatures are very low, freezing under snow cover is quite limited. Because of these limitations, correlations that have been established between freezing index and depth of frost penetration must be used with some degree of caution.

Soil freezing depends to a large extent upon the duration of depressed air temperatures. It is customary to measure time and temperature by degree days. A negative degree day represents one day with a mean air temperature of one degree below freezing. Thus, ten degree days may result when the air temperature is  $31^{\circ}\text{F}$  for ten days or when the air temperature is  $22^{\circ}\text{F}$  for one day.

A cumulative plot of degree days versus time results in a curve such as shown in Figure 16 (a). The difference between the maximum and minimum points on the cumulative degree day plot has been termed the freezing index.

The freezing index in turn has been correlated with depth of frost penetration. Figure 16(b) presents an empirical curve which relates depth of frost penetration to freezing index for a well-drained, non-frost-susceptible base course. These data can be used to estimate depth of frost penetration below a pave-

ment kept free of snow and ice. Several formulas have been presented for predicting depth of frost penetration. These have wide adaptation for a variety of cases and, in general, relate depth of freezing with the freezing index, coefficient of thermal conductivity and volumetric heat of latent fusion (9).

#### Loss of Strength During Frost Melting

It is possible for pavement distress to take place because of loss of subgrade supporting capacity during the frost-melt period. This



● FIGURE 17. Breakup of a flexible surface resulting from subgrade freezing.



phenomenon is called spring breakup. Spring breakup occurs immediately after a quick thaw during the spring of the year. Under this condition, the subgrade thaws from the top downward with the result that a layer of unfrozen material exists immediately under the pavement. The supporting capacity of the pave-

ment is thus greatly reduced. Factors which accentuate severe spring breakup include periods of high rainfall during the fall and winter, resulting in a high degree of saturation of the subgrade and, more critically, periods of high rainfall during the frost-melting period when subgrade strength is lowest.

## SUBDRAINAGE

The adverse effects of poor drainage on the performance of highway and airport pavements are well known. It is paramount to take into account the removal and interception of all troublesome water. The judicious and proper selection of subgrade drainage is primarily a construction problem. The construction engineer must recognize bad ground water conditions when encountered during excavation and determine the location of subgrade drains. Water bearing strata which will possibly feed water into the pavement structure should be intercepted some distance away from the roadway section. Ditches should be constructed to such a depth as to insure that free water in the ditch will always be below base course level. Figure 18 shows typical drainage installations that may be adopted.

Experience has shown that the use of proper backfill material around a subdrain is important. If large-grained, open-graded backfill material is used, the possibility exists that the drain will become

clogged because of infiltration by the surrounding soil. Laboratory tests made by the Corps of Engineers (10) have indicated that the proper gradation of a backfill material (filter) is a function of the grain size of the soil.

$$\frac{15\% (a)}{85\% (b)} \geq 5 \dots\dots\dots (1)$$

Where

- (a) = size of backfill
- (b) = size of adjacent protected soil

The above relationship will give the lower limit of fine sand required in the filter but the 15 percent size of the filter material need not be less than 0.1 mm if the soil is cohesive. To make certain that the backfill material is more pervious than the soil to be drained, the following relationship is used:

$$\frac{15\% (a)}{15\% (b)} \geq 5 \dots\dots\dots (2)$$

If the subdrain is to be used only for draining free ground water, an

impervious cap of clay or other suitable material generally is placed over the backfill to alleviate the possibility of surface infiltration which may clog the backfill and drain. Locations of subdrains may in some instances be determined from the soil exploration program, but many times troublesome areas are missed entirely because of climatic variations. If the exploration program is carried out during the mid-summer months the ground water table may be low and the soil may appear to be firm and dry, whereas during construction the contrary is found to be true.

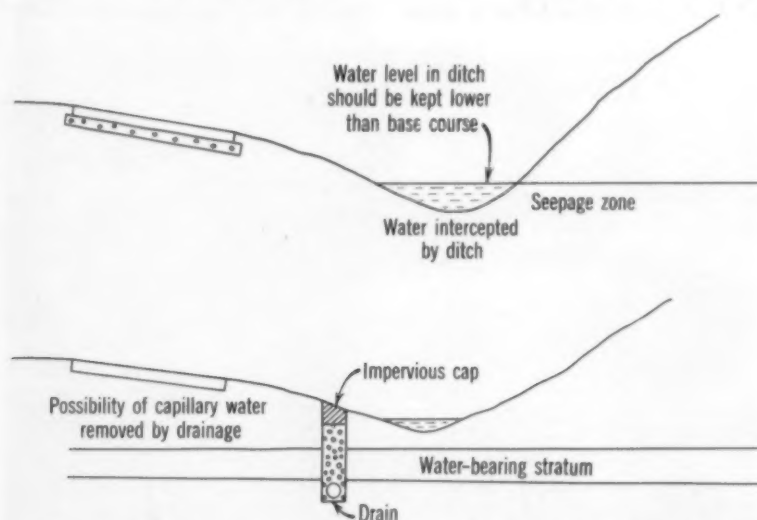
When highway or airport pavements are constructed in relatively flat areas, elevated grades should be used. This will tend to minimize the bad effects of both surface and ground water.

Considering next the function of base course and subbase course drainage, permeability of granular materials is dependent upon grain size distribution, grain shape and relative density. Generally, a free-draining base course with provision for adequate subdrainage is to be recommended. However, in some cases costs may preclude the use of a drainable material. In these cases, drains are not used but the design includes high densification of the base and the base may be constructed in a trench (see Figure 1). Even so, experience has shown that an improperly compacted, dense-graded base course built in a trench may trap water at the interface of the pavement and base course.

It is common practice in most parts of the United States to use drain pipe installed at pavement edge in cut areas, but to carry the base course through the shoulder in fill areas with the intent of draining the water to a free outlet at the outside slope.

Depending upon the pavement profile, it may be advantageous to construct an open-graded base course in a trench and merely drain it at low points on vertical curves. For these cases the drains may be installed in a transverse direction over the entire width of the pavement.

For both highway and airfield pavements, benefits derived from proper drainage cannot be over emphasized. However, the question of whether or not to install drains is largely an economical one. In areas where use of low cost aggregates which are not free draining is indicated, it may be more economical to construct a base course in a trench without drainage. On



From Principles of Pavement Design by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

● FIGURE 18. Typical examples of subgrade drainage installations.



the other hand, if the base is built using a drainable material, use of subdrains as an added factor of safety against subgrade saturation is to be recommended. In all cases it is desirable to make certain that all surface infiltration is minimized.

## SUMMARY

The preceding paragraphs have indicated in brief some of the design problems encountered when designing airfield and highway pavements. It has been the intent of the author to present the basic principles involved without covering the many details beyond the scope of this article.

Parts II and III will deal with design concepts as applied to flexible and rigid pavements. Factors to be considered will include analysis of traffic, subgrades, subbase courses, base courses, and the design for protection against frost action. Several methods of design currently in use by engineers will be presented for purposes of illustration.

### Footnotes

1. For an excellent discussion of pavement performance see Highway Research Board Bulletin 187, published in 1958.
2. The Benkelman Beam was invented by A. C. Benkelman, flexible pavement research engineer, AASHTO Road Test. This instrument was de-



● FIGURE 19. Water draining from an open graded base course constructed under a rigid pavement. This base course was placed in a trench with no provision for drainage. Water drained through the small ditch in the shoulder for several hours.

- veloped for use on the WASHO Road Test.
3. For a description of the use of this instrument see the article by W. N. Carey, Jr. and P. E. Irick entitled "The Pavement Serviceability—Performance Concept." Highway Research Board Bulletin 250.
4. Highway Research Board Special Report No. 4 entitled "Final Report on Road Test I-MD" and Highway Research Board Special Report No. 22 entitled "The WASHO Test Road. Part II, Test Data, Analysis and Findings."
5. See the paper by Frank M. Melinger, James P. Sale and Thurman R. Wathen "Heavy Wheel Load Traffic on Concrete Airfield Pavements," *Proceedings Highway Research Board*, 1957 and the final report on the Maryland Test Road.
6. Corps of Engineers "Study of Channelized Traffic," Waterways Experiment Station, Technical Memorandum 3-426, Vicksburg, Mississippi, February, 1956.
7. See for example Baker, R. F., "Principles of Soil Engineering," published by PUBLIC WORKS Magazine.
8. Corps of Engineers "Engineering and Design, Pavement Design for Frost Conditions" EM-1110-345-306.
9. Aldrich, Harl P., "Frost Penetration Below Highway and Airfield Pavements," Highway Research Board Bulletin 135, 1956.
10. Corps of Engineers "Investigation of Filter Requirements for Under Drains," Technical Memorandum No. 183-1, U. S. Waterways Experiment Station, Vicksburg, Mississippi, 1941.

*Editor's Note: Parts II and III of this series will appear in the April and May issues.*

## NEW SHOPPER'S MALL IS BRIGHTLY LIGHTED

M IAMI BEACH'S new Lincoln Road Mall, where flowers and merchandise go hand in hand, is the result of a concerted effort by property owners on the famous street and the City of Miami Beach. It was constructed with funds provided by a municipal bond issue for \$600,000. Aim was to remove traffic from Lincoln Road, except for the cross streets, and to make an eight-block promenade for shoppers. Adjacent is municipal parking.

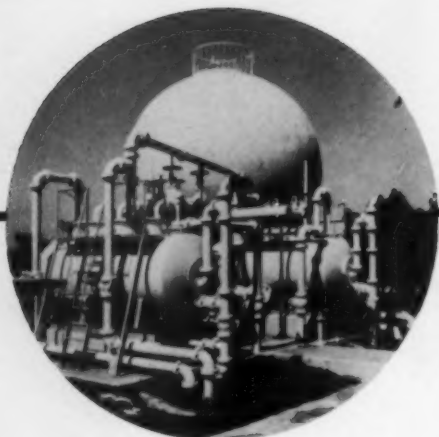
Already the Mall is drawing thousands of visitors who are anxious to view Miami Beach's newest attraction and at the same time to examine merchandise in the 200 or so stores along the Mall.

Designed jointly by hotel architect Morris Lapidus, and the city parks department headed by John Poulos, the Mall incorporates the flavor of several parts of the world. Brazilian black-and-white striped sidewalks lend a South of the Border touch; the display and shade structures, with their modernistic designs, tie in with today's architecture; and the plantings link together North, South, East and West.

Special lighting makes the Mall just as attractive after dark as during the day. Eleven Kerrigan galvanized steel floodlighting standards, each 60 feet tall, are used to support 46 spotlights that illuminate the entire width of the Mall.



● NIGHT view of a section of the Lincoln Road Mall in Miami Beach.



# GAS SCRUBBING

## For H<sub>2</sub>S Removal and Methane Enrichment

**A. M. BUSWELL**  
Consultant,  
Gainesville, Florida

SOON after the sewage treatment plant at Miami, Florida, was put in operation the digester gas was found to contain up to 600 grains of H<sub>2</sub>S per 100 cf or nearly 1 percent by volume. This was a serious matter since the gas was to be used for power production and 60 grains per 100 cf was the limit set by the gas engine manufacturers for use in internal combustion engines. The value of the gas was approximately \$100 per day. The high H<sub>2</sub>S content of the gas was not anticipated since the city water was low in sulfates which are in general the source of H<sub>2</sub>S by reduction under anaerobic conditions (1).

Analyses of the sewage showed chlorides and sulfates in high amounts which on further investigation were traced to infiltration of ground water of high salinity due to salt water intrusion (2). Repair of sewers and increase of solids content of raw sludge resulted in a reduction of the H<sub>2</sub>S content of the gas by about 50 percent. For the past three years the H<sub>2</sub>S has ranged from about 200 gr. per 100 cf in wet weather to 300 gr. per 100 cf in dry weather.

At about this juncture, C. F. Wertz, Director, Dept. of Water and Sewers of Miami, applied to Harry E. Schlenz, President, Pacific Flush Tank Co. for advice concerning possible methods of gas purification. Mr. Schlenz, after some study and inquiry, came to the conclusion that no very satisfactory method for H<sub>2</sub>S

removal was available or in use and requested the writer to investigate the whole problem of removing H<sub>2</sub>S from gas under the conditions existing at Miami.

### **Peculiarities of the Problem**

Methods in current use commercially for removal of H<sub>2</sub>S from gas are designed to handle relatively huge volumes (millions of cubic feet per hour) of a gas of moderate H<sub>2</sub>S content which must be removed to a very low value. The gas treated (usually natural gas or coal gas) is also low in CO<sub>2</sub>. Digester gas here encountered was high in H<sub>2</sub>S but needed removal to only 60 gr. per 100 cf. Digester gas is also high in CO<sub>2</sub> which for chemical reasons interferes with the efficiency of preferred methods for H<sub>2</sub>S removal. Thus, both from the standpoint of size of installation required and suitable chemical reaction available the scrubbing of digester gas presents a unique problem, and little help for its solution is available in the literature.

The basic problem in gas scrubbing depends on two well-known facts: First, when a liquid surface is exposed to a gas, enough gas molecules strike that surface to saturate the surface layer almost instantaneously (3); but second, the dissolved gas molecules diffuse into the body of the liquid at an exceedingly low rate (4). The ideal scrubber would present the liquid to the gas in a monomolecular layer. For obvious mechanical reasons this would be difficult to accomplish in practice. A practicable approximation of the ideal condition may be obtained by presenting a continu-

ally changing or new, water surface to the gas. This condition is attained to a degree by methods 1 and 2 cited below.

The importance of counter current flow must also be emphasized. The situation is similar to that in a heat exchanger. Just as the rate of heat transfer depends on the difference between temperatures, so does the rate of solution of a constituent of a gas mixture in a liquid depend on the relative amount (concentration) of the gas constituent in the gas phase and the amount already dissolved in the liquid.

### **Scrubbers Using Liquid Absorbents**

Four mechanical means are in common use for scrubbing gas:

1) *Packed tower.* A tower filled with broken rock or equivalent to which absorbing liquid is introduced at the top and the gas at the bottom. Changing surface and counter current flow are attained but capacity per unit volume is low and maintenance is high due to clogging.

2) *Jet injector.* A second type of scrubber and one which appears to be gaining in popularity is the injector or venturi type in which the water is applied as a jet, preferably through a restricted throat creating a suction which draws in the gas, compresses it and at the same time brings it into contact with a continually changing water surface. Counter current effect is obtained by operating several injectors in series.

3) *Fine bubble diffusers.* A third type uses perforated metal or porous plates submerged in the liquid to

disperse the gas. The counter current principal is applied in this type of scrubber by arranging several tanks in series or by dividing a tank into separate compartments. The piping is so arranged that the liquid flows in the direction opposite to the flow of gas.

4) *Liquid spray.* The fourth method is to spray the water in a fine mist into the gas stream. Here there is no change in water surface unless the mist droplets coalesce and then redispersed. This condition is probably not realized in practice.

Neither the bubble nor spray produce a changing water surface. This was demonstrated for bubbles by Buswell and Neave (loc. cit.) and the situation is similar in the case of fine mist droplets. The absorptive action in these cases is practically instantaneous and the active phase must be collected and redispersed before additional absorption takes place.

### Chemical Factors

1) *Solid surface absorption.* The conventional method for absorbing  $H_2S$  from coal gas involves oxidation with ferric oxide. The chemistry is complicated and a detailed discussion of the reactions is not justified here. The oxide is carried on hard wood shavings which are supported in baskets. When exhausted it is regenerated by removing the baskets and exposing the iron sponge to air. The sulfur is spontaneously oxidized, sometimes

with a violent reaction. At Miami approximately 200 cu. ft. of sponge would have to be regenerated and replaced every 100 days.

### 2) Chemistry of liquid scrubbers.

a) *Water.* One volume of water will dissolve three vols. of  $H_2S$ , and water at this ratio to a gas mixture should remove the  $H_2S$  if operating at 100 percent efficiency. Even with high efficiency, water would be expensive under most conditions. But in this particular case plant effluent is available for the cost of pumping. At Miami, plant effluent is pumped back to the elutriators in considerable volume so the only cost is the operation of a booster pump to supply the necessary head for the scrubber. b) *Alkaline solutions.*  $H_2S$  is a weak acid and its alkali metal and amine salts are highly soluble so that small volumes of their solutions will scrub large volumes of gas. But the cost of these chemicals is prohibitive unless they are regenerated for reuse. An installation to treat the Miami gas with ethanolamine was estimated to cost \$50,000. Lime or soda would be less expensive but still out of range. c) *Oxidizing agents.*  $H_2S$  is easily oxidized to  $H_2O + S$ . Pure  $O_2$ ,  $SO_2$ , and chlorine compounds were considered. Oxygen requires the presence of a catalyst such as cobalt for the oxidation of  $H_2S$  in solution and its use was not considered practicable.  $SO_2$  reacts according to the equation:



Experiments with this reaction were not favorable. Chlorine reacts with  $H_2S$  as follows:



A similar reaction takes place with HTH. An excess of chlorine produces sulfates and the efficiency drops sharply (5). Other oxidizing agents such as ozone or peroxide might also be considered. (d) *Precipitants.* Salts of metals which form insoluble sulfides were considered. Iron and copper salts were tried and results are reported.

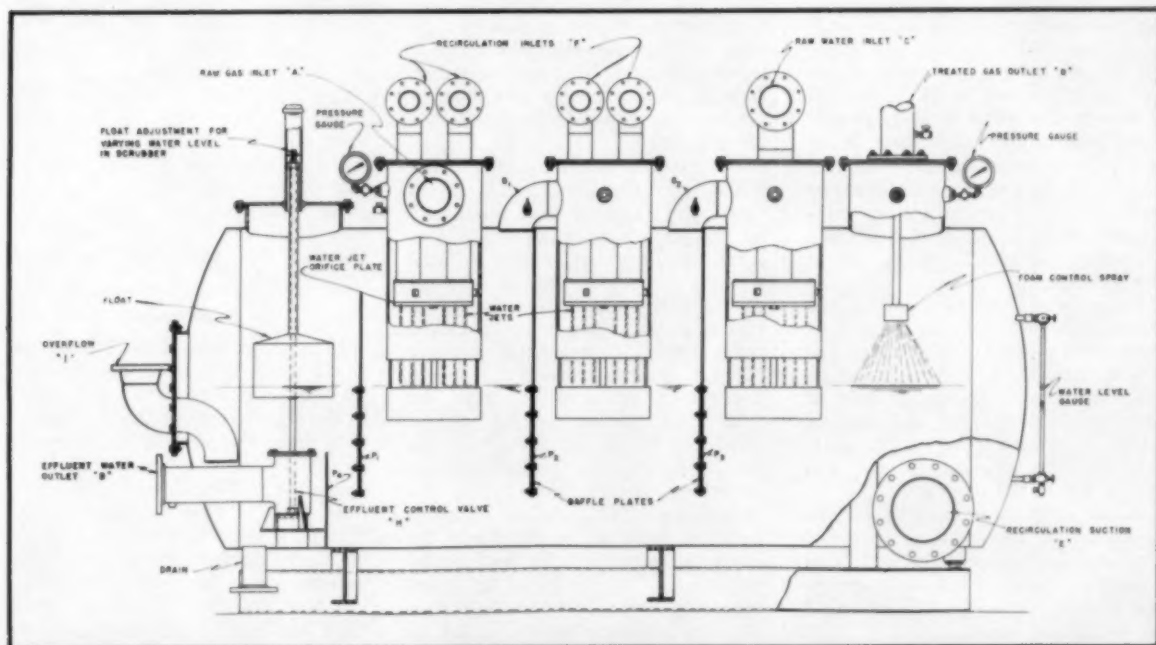
### Experimental Studies

After a review of factors cited above and of some past experiences, the tank type of scrubber was selected for the pilot plant study.

A cylindrical tank 3 ft. by 6 ft. was constructed by Pacific Flush Tank Company to be used for experimental studies of design factors for construction of a scrubber to treat the entire gas volume.

The tank was first erected in a vertical position with the water (plant effluent) and gas entering at the bottom through connections as required. The water was taken off at the 4-ft. level and the gas was taken off near the top and discharged through a flame trap to a flare. A water connection at the top was provided for experiments with various spray nozzles.

From an hydraulic standpoint operation was difficult. Gas was carried out with the discharged scrubber liquid in amounts approaching



● SECTION through scrubber for removal of  $H_2S$  from digester gas to permit use of gas in engines for power generation.



25 percent of the gas flow. At high gas rates water was carried out with the gas. No improvement was shown when either  $\text{CuSO}_4$  or  $\text{FeCl}_3$  were added to the scrubbing liquid even in amounts two to four times that required for complete removal of the  $\text{H}_2\text{S}$ . HTH at chlorine concentrations of 325 mg/L gave low efficiencies.

### Change of Design

It was decided on the basis of above results to remodel the scrubber placing it in a horizontal position and providing appropriate baffles and traps to separate the gas and water before discharge. At the same time it was decided to employ an injector or venturi type device to obtain intimate contact of gas with liquid with changing interface.

In the pilot scrubber, as rebuilt, raw gas is introduced into the head of the injector and driven down into the water which is carried at mid-tank level. The gas leaves through a large dome at the right top and the water leaves at the right bottom. A baffle avoids entraining bubbles in the water as it leaves. It was found necessary to provide ample trap facilities to prevent high velocities in the discharged water. Gas losses as high as 25 percent were encountered at first but as finally trapped the apparent loss was within the limits of the metering accuracy. The unit did not provide for counter current flow since it had only one jet tower. The jet injector type of aerator proved to give better results than the various aerators previously tried. At gas to water ratio of 1.25:1 and raw gas under 200 gr. per 100 cf, the scrubbed gas was easily reduced to 60 gr. per 100 cf or less. Operating at 30 to 50 cfm there was trouble with foam being carried over with the scrubbed gas. The installation of three Binks spray nozzles in the gas exit head permitted the application of a silicone antifoam compound which solved the difficulty.

As soon as operating difficulties were smoothed out the pilot unit was found to have a capacity of 30,000 to 70,000 cfd. It was therefore put into service to supply part of the fuel required for the engines used to operate the plant. Incidentally this amount of gas was worth \$10 to \$20 per day.

After some four months of observation of this unit it was felt that sufficient experience had been gained to design a full scale scrubber to treat the entire gas produced by the Miami plant.

The gas scrubber consists basically of a cylindrical structural steel

tank 5 ft. in diameter and 12 ft. long mounted in a horizontal position. Three scrubbing towers are incorporated in the unit, operated in stages. Counter current flow of gas to water is provided with the gas inlet in the first stage scrubbing tower and the water in the third stage. The liquid level is automatically maintained constant at about the center of the tank by means of a float chamber.

The scrubber is divided into four compartments by vertical baffles. One acts as a stilling chamber and the other three contain the stage scrubber jet assemblies, which are provided with removable orifice plates with multiple orifices to provide jet streams discharging vertically downward into the liquid in the scrubber tank. The scrubber towers consist essentially of a cylindrical casing extending down below the water line with a 6-in. annular opening projecting upward from an elevation approximately at the water line. The downward force of the streams of water produce a jet action, sucking the gas from the area around the tower in through the annular opening in the chamber wall, compressing the gas and forcing it into the water.

Water or plant effluent is recirculated by a pump taking suction at the bottom of the final stage compartment and discharging to the top of the scrubbers in the first two stages. Provision is made for adjusting the float to control or vary the water level in the scrubber. An auxiliary overflow line is provided to take any excess water which is not handled by the float control valve. This is an emergency overflow to prevent the water from rising into the gas lines.

The raw gas enters the side of the initial scrubbing tower and is drawn down and injected into the liquid by the jet action, being exposed to a continually changing and agitated water surface. The gas is released at the water surface into the initial section of the chamber isolated by a baffle plate. In a similar manner the gas is drawn from this initial portion of the scrubber into the cylindrical portion of the second scrubbing tower and is sucked into the jet streams in the intermediate scrubbing tower, passing into the intermediate section of the scrubber between baffle plates. Similarly the gas is reinjected into the final scrubbing tower. It was found in actual operation that under certain conditions satisfactory results could be secured by eliminating the recirculation to the intermediate scrubbing

tower. The gas would then merely pass through this center section and be sucked into the final scrubbing tower.

It was also found that in the final section of the scrubber there was a tendency to foaming. The foam control spray, in which an application of defoamant was injected, controlled this problem adequately.

From the above description it is seen that a three-stage counter-current system is used with the injector action of the jets providing a very effective means of continuously exposing fresh water surfaces to the gas. A slight increase in gas pressure is obtained which allows the unit to be placed in any existing gas system.

**Operating data.** For routine operation of the scrubber the gas rate is set at 150 to 170 cfm, and the water rate is 70 to 75 cfm. For a typical 25-day period from May 20 to June 14, 1959 when the raw gas had an average  $\text{H}_2\text{S}$  content of 240 gr. per 100 cf the scrubbed gas had an average  $\text{H}_2\text{S}$  content of 43 gr. per 100 cf. During this period the water (chlorinated effluent) carried an average of 8 mg/L residual chlorine which is calculated to account for 20 percent of the reduction in  $\text{H}_2\text{S}$ .

Routine determinations of  $\text{CO}_2$  content were not made but twenty random samples showed an average reduction from 35 percent  $\text{CO}_2$  in the raw gas to 25 percent in the scrubbed gas. The removal of  $\text{CO}_2$  not only enriches the gas but also decreases the storage volume required to equalize variations between rate of production and rate of consumption of gas.

**Experiments in progress.** Further work is under way to determine more exactly the effect of chlorine, the best operation of  $\text{CO}_2$  removal and the most efficient recycling program. A second full scale scrubber has been installed to provide a standby and to handle increased future load.

### Summary

1) High sulfates from infiltration of sea water into sewer lines caused an  $\text{H}_2\text{S}$  content of 600 gr. per 100 cf in the digester gas at Miami, Florida.

2) Repair of sewers and increase in solids content to the digesters reduced the  $\text{H}_2\text{S}$  by about fifty percent.

3) After a year of experimentation on a laboratory and pilot plant scale, a three-stage injector type scrubber was installed to use effluent water as the absorbing liquid. This has been in successful operation for over a year, producing a  
(Continued on page 194)



# Caddis Flies, Fish and Power Plant Condensers

J. W. RUFF

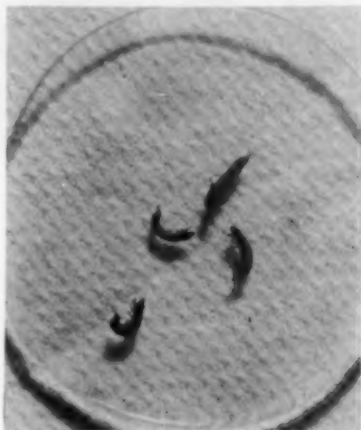
Chief Chemist,

Muskingum River Generating Division,  
Ohio Power Company,  
Beverly, Ohio

**D**URING the summer of 1959, an infestation of caddis flies plagued the Muskingum River generating station of the Ohio Power Co. at Beverly, Ohio.

They were first noticed but not identified during a routine examination of the water boxes on one of the condensers in late June. Portions of the walls, tube sheets and stay bolts were found to be covered with a fibrous matted material, which seemed to be composed of mud, grit, sand and debris held together with a silk, web like material. A number of insects were crawling on and in this material, small, greenish and about  $\frac{1}{4}$  to  $\frac{1}{2}$  inch long. A few of these were taken to the laboratory and under the low power of the microscope, looked exactly like small shrimp. As the tubes were clean and bright in the condenser, nothing much was done except to hose off the area with water under high pressure. The boiler and unit were brought back on the line four days later and the information concerning the worm incident was written up and laid aside. However, the chlorine feed to the cooling water was substantially raised to better than 1.0 mg/L for periods of  $\frac{1}{2}$  hour to several hours as a precautionary move.

A month later this incident was repeated when another unit was removed from service. By looking closely this time, one could see these insects coming out of small tunnel like openings  $\frac{1}{2}$  to 1 inch deep in the matted fibrous material. It was evident that the insects were living in "cases" of their own manufacture. Samples were scraped off and



● LARVAE of *Trichoptera*, the caddis fly, shown about natural size. These insects caused clogging in condensers.

sealed in bottles of water in which formaldehyde was used as a preservative. A few days of hot weather, with the water boxes drained, resulted in the death and decay of the insect and the resulting odor was very disagreeable, necessarily limiting inspections.

In October, 1959, a partial plug-gage occurred in a Hankison condensfilter on the air supply to a condenser. When a  $\frac{3}{4}$ -in. elbow was removed, a large number of the same type of worm were found in the elbow, plus a quantity of cases. They were quite alive and the colder river water had not impaired their ability to make cases. The question then arose: How do you protect filters and piping when small flows of water are normally used: The remedy in this case was to repipe with new fittings and clean out the Hankison as best as possible by mechanical methods.

Our primary concern over the invasion of the pes's resulted from the realization that they could plug a condenser if their activity were not checked. This led to investiga-

tions during the summer into the cause of the infestation and of possible corrective measures. It was through the assistance of A. E. Griffin of Wallace and Tiernan Co. and later Dr. C. M. Palmer of the Robert A. Taft Sanitary Engineering Center that the identity of the insects as caddis fly larvae was suspected and later confirmed.

Both the adult fly and the larvae are natural food for fish. Dr. Palmer suggested that there may have been a decline in fish population in the river source of condenser water to account for this infestation.

## Life Cycle

The writer started his own research into the caddis fly and its amazing life history. The only information available is in textbooks on entomology. The classification of the caddis fly follows this general outline: It is of the order *Trichoptera* (which means hairy winged); family, probably *Hydropsychidae*; genus, *Potamyia*; the species was not identified.

The flies that were caught and examined were of two kinds, one had a mottled brown wing while the other had wings colored a light tan. They were small fragile flies about  $\frac{1}{2}$ " long with antennae as long as the fly itself. In the summer the plant was filled with them and numerous specimens were found in the laboratory. At night the lights outdoors attracted millions of them and even 25 miles away at home, they were noted for their quick attraction to an outdoor light. In less than one minute after a porch light had been turned on, the whole area was swarming with them. In fact yellow bulbs had to be used to help keep them away. The adult female fly probably has a short life span but as recent as October 22, several specimens have been observed flying around in the laboratory.



● OBSERVATION door of one of the condensers swung out to show collection of cases covering area to depth of about half an inch. Paper clip is size reference.

The eggs are laid directly on or in water on twigs, logs and rocks. Recently a small log was pulled up by the trash rakes in the screen house and a group of eggs was observed under the bark plus hundreds of worms, some so small, a microscope was used at better than 10X to see them. From present conclusions, the eggs hatch in the warm water and as soon as larvae float they select a favorable environment where they can start making their cases. The caddis worm can leave the case for food, usually of vegetable origin. An interesting thing about these insects is that all known species either drag their cases with them or use them as fixed houses. In the water boxes here, cases are fixed in such a way that they partially cover a condenser tube opening, and it appears that they do this in order to stay in their cases and have a fresh supply of water, loaded with food, brought to them. They prefer the discharge side of a condenser tube, possibly more suitable in water temperature, and they place their cases lower down in the water box, near the bottom of the banks of tubes. They do not care for the hot parts of the condenser, yet want to be on the discharge end of the tubes. Large areas of cases covered the observation doors.

#### Attempts at Correction

Actually the problem from a practical view is the accumulation of used cases that clog up and cover the equipment. The water boxes of No. 3 condenser were thoroughly washed down to get rid of the mag-

gots that eat the dead caddis worms and to freshen up the area. The cases were then scraped off as best as possible with tools. Several days were spent on this, and it was not a pleasant job during the hot weather.

An observation of No. 1 condenser during a recent outage revealed few signs of caddis worms and the following reason is given:

There are at Muskingum River Plant 4 units, consisting of Units 1 and 2 built during the 1952-1954 period and the 3 and 4 units built during 1956-1958. The latest units have a different condenser arrangement from the first two, and have

a water box at each end of the condenser divided into two independent, vertical sections, thereby providing two parallel circuits through the cooling tubes. By means of valves on each end, the flow of water to a condenser can be reversed. Usually every week the flow of water was reversed through the 1 and 2 condensers during the summer. The 3 and 4 condensers are designed in such a way that the flow of water can be partially reversed for backwashing but the normal flow pattern is always the same. Both types of condenser used about 180,000 gpm of raw river water chlorinated twice daily for two ½-hour periods to a residual of 0.50 mg/L chlorine.

So the frequent change of flow in units 1 and 2 upsets the environment that the caddis worms enjoy and therefore they will not inhabit those condensers and/or water boxes. The flow of water through 3 and 4 condensers, with exception of brief backwashing periods is constant and in one direction. Consequently the environment is more suitable and the worms flourish on the discharge end of each condenser.

The condensers are checked annually and 1959 was the first year these worms had ever been seen in numbers as would make them conspicuous. What control measures would destroy them, no one seems to know at this time. Probably this infestation is cyclic and they may never appear again. They did not return in appreciable numbers in 1960, possibly because of an increase in fish population in the river above the plant site.

## 10-MG Tank Features Construction Economies

Construction costs were cut in three ways on the 10-million gallon water tank built for Kennewick, Washington. First, prestressed concrete construction was specified to permit thinner wall sections. Second, the tank was designed so that a portion is below grade. And third, the roof is of corrugated asbestos supported by timber.

The tank measures 248 ft. in diameter, with the top of the wall 19 ft. above the top of the footing. The floor slab is 10 ft. below the footing and is in the form of a saucer, with the sloped portion joining the wall footing. The 9-in. thick reinforced concrete wall was cast in vertical sections. Plastic waterstops were used to seal horizontal and vertical joints.

To enable the relatively thin wall to withstand internal pressure, the wall was prestressed by wrapping it with steel wire under tension. This prestressing work, as well as tank design, was by The Preload Company, New York, N. Y.

The corrugated asbestos roof is designed for a dead load of 11.5 psf and a live one of 40 psf. It is supported on timber beams and purlins which in turn are supported on concrete columns on 18½-ft. centers.

The structure is in an earthquake area and 52 concrete antibuckling blocks were placed along the base of the inside circumference of the wall after prestressing. The blocks are doweled to the floor and are on approximate 15-ft. centers.



## REFUSE BURNER SUPPLEMENTS TOWN LANDFILL

**DANA WHITMAN, JR.**

*Town Manager,  
Newton, New Jersey*

**A** BURNER, shaped like a wigwam was recently placed in operation for refuse incineration by Newton, N. J. This was a Model 45 Wilco refuse burner, purchased from Wilco Machine Works, Memphis, Tennessee. This model has a base diameter of about 45 feet, a slant height of about 46 feet, and an overall vertical height of about 50 feet. The unit is constructed of panels of aluminized steel, bolted together, and is equipped with an inner liner of aluminized steel panels. The dome of the burner is covered with pre-cut steel wire mesh. There is a catwalk, with a safety rail around the dome, and an access ladder.

Draft is supplied by 53 inward opening adjustable draft doors, three in the bottom of each panel. In Newton, we selected the dual forced draft system, which, in addition, provides two sets of 4 grate boxes and grates fed by electric blowers, powered by General Electric motors.

The unit has 3 doors as follows: one 3-foot by 6-foot walk-in door; one 9-foot high, 13-foot wide clean-out door; and one 16-foot high, 11-foot wide, charging door. The charging and clean-out doors are double-opening, double-hung with vertical axis hinges.

The burner was purchased, delivered in Newton, for \$13,226. The concrete base and footing were constructed by Town personnel. The metal erection was completed by John Caruso and Son, Franklinville, New Jersey, for the sum of \$2,745. The wiring of electric motors was handled by a local contractor.

The unit was placed in operation on October 29th, even though the forced draft system was not quite complete. Since collections are made by local scavengers, combustible refuse must be accepted at the burner site whenever a truck arrives. At present they discharge their loads directly into the unit. It is planned to use force account to construct a concrete apron and windbreak. This will provide some storage area, after which the Town forces will handle feed to the burner unit using the Town's Caterpillar Traxcavator 933. This change will reduce possibilities of liability in case the fire should spread to a privately owned truck.

Railroad ties will be placed above the forced draft grates and grate box to protect them when the bulldozer runs through the unit for a periodic clean-out of ashes. Newton employs batch feeding of burners; however, continuous feeding is possible by installing a conveyor or loading ramp, if desired.

The fire burns continuously during the day, six days a week. It must be ignited each morning, but this is easily done. Presently the unit is cleaned out once a week. Very little residue remains since only selected combustibles are charged to the burner. Naturally, however, a certain amount of glass and metal is unavoidable even in separate collections.

The Wilco refuse burner was originally designed for the disposal of sawdust in mills. Units are used to handle bark, slabs and edgings, shavings and dust, corn cobs and

shucks, peanut shells, cotton gin wastes, etc. In New Jersey there are presently several installations in factories and institutions. We believe Newton's installation is the first municipal installation in the State.

The burner's characteristic is its circular draft action. Cool air enters through the circular draft doors, replaces rising hot gases and whirls around the refuse to confine the flame, insulate and cool the metal skin and supply "overfire" air for combustion.

Newton has a limited amount of suitable land for landfill disposal of garbage and rubbish. In addition, local industries and businesses have above average amounts of combustible wastes that are brought to our disposal grounds. Combustibles, particularly paper and paper products, will not easily compact. Since suitable land is limited, and large volumes of wastes are combustible, we concluded burning of combustibles would conserve valuable space and enable us to handle this large volume without undue difficulty.

In connection with the erection of this burner, a new regulatory ordinance, covering public collectors of garbage and rubbish was adopted. The ordinance requires the separation of combustibles and non-combustibles, an annual license fee of \$10 per year and covering of vehicles; and prohibits dumping of materials from out of town. Combustibles from outside of village limits may be disposed of in the burner on a fee basis.



# STANDARDIZATION IN ENGINEERING TEST PROCEDURES

**JOHN ROBINSON DAVIES**

Manager in Europe,  
Soiltest, Inc.

**T**HE INTEREST in engineering testing of materials such as soils, concrete and asphalt is ever increasing on an international scale. More and more engineers, architects, contractors, governmental agencies and similar groups are becoming involved in testing for design and quality control, but there is a definite need for standardization to bring about a uniformity in testing procedures.

Ten or fifteen years ago most of the testing operations were performed by graduate engineers. As the work load increased, these engineers supervised technical personnel and now a very high percentage of the engineering testing

work is performed by specially trained technicians.

This alone has developed the need for standardization in test procedures. With an experienced graduate engineer performing the test, the engineer had complete control over all portions of the test through his knowledge of the theory, method and analysis. The engineer usually carried the entire operation from start to finish, had his own control, and was able to make adjustments in his procedures or analysis based on the needs of his specific project.

Today there is a shortage of engineers which makes it impossible to conduct this type of testing program. Much of the work must be delegated to engineering technicians—and the tests must be standardized.

Engineers have been involved in testing concrete for many years and as a result the specifications for this type of work have been pretty well developed. Everyone is familiar, for example, with the standard compression tests of concrete cylinders or cubes and with the slump test. There are tests for gradation of the aggregate and for quality control of the aggregate.

In the same manner there have been tests standardized for the various physical and chemical characteristics of cement. Concrete, as a manufactured product, lends itself easily to standardization in testing.

In the civil engineering field, concrete tests have recently been performed in the field by concrete producers, architects representatives, field men and by engineers. These field tests are primarily for determination of quality of the product in meeting a designated specification.

Around the world there is good uniformity in the standardization of concrete tests. Most countries use the standard slump cone and have specifications which call for the concrete cylinder or cube compression



● **LIQUID LIMIT** testing machine lifts cup 1 cm and allows it to drop. Number of drops needed to close groove partially are counted and then correlated with the moisture content to find liquid limit.

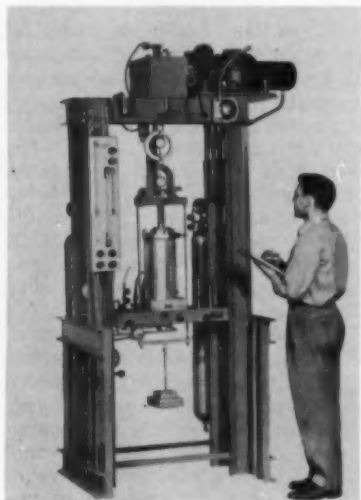
test, the use of yield buckets and control of the aggregates used.

## Soil Testing

Standardization in soil testing is a different matter. Here the product is infinitely variable. In most instances, little is known of the materials which are to be used in construction. The classification and knowledge of the physical characteristics of the material must be analyzed through testing procedures before the project is to begin.

The basic tests for soil classification are widely accepted. These include the Atterberg Limit test of liquid limit, plastic limit and shrinkage limit. Even though these procedures may not be called for in a national standard in a specific country, the tests are used in almost every country of the world following perfectly the procedures outlined in the specifications of the American Society for Testing Materials (ASTM).

Another series of tests widely accepted internationally is the Proctor moisture-density test. Most coun-



● **HIGH capacity Triaxial apparatus** for shear tests of soils, soil cements and bituminous materials in the laboratory. The testing machine has a loading capacity sufficient for all normal tests.



tries are using the standardized 1/30 cu. ft. mold and a standard 5.5-lb. hammer which has a 12-in. drop, or the modified compaction hammer of 10 lbs. with an 18-in. drop.

The Proctor Penetrometer, which is not called out in specification, has been widely used in most countries of the world to develop a correlation between the laboratory compaction studies and the compacted materials on the jobsite.

Use of uniform standards in various countries has made it possible to exchange ideas between research groups and those employing these methods in practical applications. This exchange of information has helped to advance rapidly the knowledge in the field of soil mechanics. Yet there is still so much to be done in the field of standardization of soil testing procedures that it is virtually impossible for any one country to work completely independently in setting its own standards. There is a need for more international cooperation in the development and acceptance of standards for testing soils.

Because of the great variety of tests performed in the field of soil mechanics, the cost of equipping a laboratory is of important consideration. There are a number of manufacturers of soil testing equipment around the world and their prices are geared to the rather high cost of producing specialized apparatus on a low volume basis. With standardization of sizes of testing equipment through the use of international specifications, these manufacturers should be able to reduce the prices substantially on some of the popular equipment items and thus put more and more equipment into the hands of the users at lower costs.

Because of the wide interest in engineering soil testing, many people who have had no previous experience with soils are becoming involved in quality control on construction projects. This involves compaction and stabilization, identification and the use of special tests such as the California Bearing Ratio (CBR) and permeability.

In any standardization program, the tests most widely used by non-engineers, should be developed into a specification. Most sampling operations are performed under the direction of an engineer, but by non-technical personnel. The reliability of any test is dependent upon the undisturbed nature of the sample used. Specifications as to types of samplers, the sizes and the operating



● **SLUMP TESTS** are used in quality control of concrete mixed in the field.

technique go a long way toward getting better samples for a test.

General specifications as to the methods to be used in classifying soil for strength, color and gradation will help to understand the language of soils. The contractors are interested in performing their own soil investigations and soil tests to assure themselves of the type of conditions they will encounter in construction activities. During actual construction they are further interested in quality control to make sure they will be in full accord with the job specifications, whether or not there is a resident inspector or engineer on the job. The contractor wants to know just when to stop a compaction roller or tamper operation. Each additional hour of operation or each additional pass costs the contractor money and he does not get paid for a higher degree of compaction than that specified.

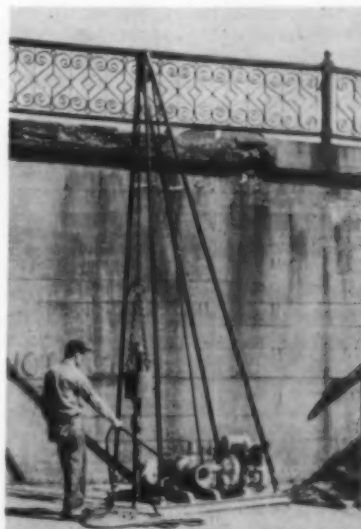
### **International Committees**

New specifications should be written in such a way that all interested users of the standard specifications should be able to comply without a great deal of difficulty. There are a number of international committees presently engaged in working toward uniform international standards. One of the most active committees is that on testing sieves. This group met recently at the Hague, Netherlands to continue their work toward development of an international sieve screen size, getting uniform specifications as to wire diameter, openings (mesh size) and manufacturing tolerances, as well as general sizes of the sieve frames. Some 13 countries are part of this international group and much progress has been made in the development of a new international standard. Copies of a special report and also of the proposed ASTM specification for sieves based on the in-

ternational proposal are available to those interested.

A great deal has already been done on the international standardization of terms used in soil mechanics. A very excellent dictionary and glossary of soils terms is available through the Swiss Federal Institute as a result of compilations made in conjunction with the 1952 Third International Conference on Soil Mechanics and Foundation Engineering at Zurich.

With engineers engaging in projects in their own and different countries in the world, one sees more and more the need for international specifications. For example, a project may be designed by a Swiss engineering company, the samples taken by a French drilling contractor, samples tested by a local laboratory, say for a project in an African country and actual construction performed by an Italian firm of contractors with construction inspection by the original designing engineer. Major projects usually have personnel from many countries involved in the design and construction. This brings about the necessity of testing standards which will be international in character. It will also assist in the more rapid development of the science of engineering testing and will bring about an increasing awareness among owners, governmental agencies and civic groups of the importance of effective testing in any construction project whether it be private or public.



● **DRIVING winch** used to obtain samples of soil for classification and laboratory strength tests. The samples are obtained in a thin wall tube or a split sectioned sampler using a drop hammer.



**ROBERT H. VAN DEUSEN**

Township Manager,  
Mount Holly, New Jersey

## **FAST, EFFICIENT METER ENFORCEMENT**

**N**ICKEL FEEDERS and all-day parkers could not be curbed when a conventional foot patrol was used to enforce the parking meter ordinance in Mount Holly, New Jersey. This community of 13,000 population has 186 street meters with parallel parking strung over a 9-block area, plus 74 parking lot meters, making a total of 260. Interspersed in the metered area are a number of loading zones and other prohibited areas, so that the street meters cover about a mile from one end to the other. Under these conditions it was impossible to complete a patrol on foot in much less than two hours. In addition, the same man who wrote summonses also repaired the parking meter mechanisms, collected money from the meters and occasionally relieved at the police radio desk or as a guard at a school crossing.

Two years ago we obtained a gasoline-powered Cushman Truckster. We equipped this vehicle with a two-way transistorized Motorola police radio and hired a meter maid. We equipped the meter maid with a handsome uniform (including

slacks for scooter riding) and, after a period of training, we assigned her the job of enforcing our parking meter ordinance. In addition, we told her to enforce all prohibited area and double parking laws in the central business district. She unsnarls traffic, assists motorists, and sees that the business area is policed constantly during the daytime hours. She uses her two-way radio to call for assistance, to report unusual conditions, to radio intercept directions to patrol cars to pick up violators of our truck route ordinance or motorists running stop signs or red lights. She also receives complaints on defective meters immediately and proceeds directly to the meter with a spare mechanism. The extra meter mechanisms are carried in the ample fibreglass storage compartment behind the seat.

The Cushman Truckster can be parked conveniently, wherever it is necessary to dismount. In a parallel parking area it can be parked perpendicular to the curb between two parked cars. The meter maid is often able to park right in front of the meter violator, quickly check the

meter, post a summons on the windshield, and be on her way. All day parking meter feeders never know when the meter maid will appear; consequently we have discouraged this practice and more space is available for the shopper.

The former meter man, now called our traffic maintenance man, still repairs the mechanisms and makes the collections. In addition, he has a panel truck and painting equipment. He does all our traffic marking and repainting and replaces our traffic signs.

The Cushman Truckster, the two-way radio, and the traffic maintenance truck were all paid for the first year by an increased yield of \$3,000 in meter revenue and an increase of \$2,500 in money received from parking fines.

The important thing is that we are now doing a better job of parking enforcement which benefits all those who customarily obey the law. In addition, we are doing a better job of maintaining our meter mechanisms and our traffic signs. We think we have made a wise investment and, in so doing, improved our performance.

# How Much Do You Spend For MOWING?

WESLEY L. HOTTENSTEIN

Assistant to the Chief Engineer,  
Ohio Turnpike Commission  
Berea, Ohio

IT SEEMS only a few weeks ago that "mowing" was an after-dinner activity in which you participated, on occasion, at the insistence of the female members of the household, or if associated with a highway department, a program which called for arrangements with abutting farmers to "sickle-bar" one swath along each side of the pavement. In the latter instance, the cutting was probably done just before each of the three summer holidays and if the "crop" contained enough timothy or blue grass the farmer took the hay in lieu of more conventional remuneration. Obviously, mowing in those days was not a major highway problem either from the standpoint of budget or personnel.

But reminiscing is not applicable to the problems of the management of vegetation along present-day thruways, freeways, parkways, turnpikes and interstate highways. Rights of way have widened from 66 feet to 250 or 300 feet or even greater. Ground cover vegetation,



● A STRIP three feet wide has been treated with herbicides, two applications per year. Some vegetation remains in the strip beneath the guard rail, but not very much.

primarily for erosion control, has become an increasingly important part of the modern highway. Roadside areas devoted to turf have expanded to such an extent that haphazard maintenance practices are no longer permissible. Instead of mow-

ing 2 acres per mile of highway as was done along many thousands of miles in 1940, we are faced today with the problem of managing as many as 25 acres per mile on a 350-foot width of right of way. At \$13 per acre per year (a conservative estimate based on appropriate equipment, well-maintained and efficiently operated, but not including depreciation costs) it will cost \$325 per mile to maintain well-mowed level and flat slope areas along a 1961 divided highway. The demands upon a typical maintenance budget will not permit the luxury of pampered "golf course greens" on many acres of roadside turf. Such mowing practices will undoubtedly evoke many favorable comments and the turf will present a neat appearance, but can we afford such high-class, city-park type maintenance? Can it be justified even from the standpoint of appearance? Many of the roadside areas within the highway right of way might better be managed so as to achieve a natural effect, thus making them an integral part of the adjoining countryside. The picture of mile after mile of neatly maintained turf areas resembling lawns and fairways is neither distinctive nor indicative of



● SOME OF the several categories of roadside vegetation—the forest area at the left, the slope beyond the ditchline and the area between the shoulder and the ditch.





● ABOUT 10,000 delineator, milepost and signpost locations have been treated with herbicides. In general, the overall results have been satisfactory and economical.

the character of the natural environment of the state or locality the motorist views.

The basic elements of good turf maintenance might be stated as follows. There is no need to mow every acre of roadside vegetation in order to maintain properly the right of way of a modern highway. A good mowing program requires planning. Roadside areas should be arranged in categories and a vegetation management program developed to fit the needs. Cultural practices and land use patterns along the right of way should dictate the roadside treatment. As a general rule, it should not be necessary to mow: Slope areas ( $2\frac{1}{2}$  to 1 and steeper); roadsides adjacent to natural woodland and swamps; and areas beyond ditch lines with dense uniform stands of desirable species of grasses and legumes in agricultural sections. There must be a reason, a justification, for mowing the various areas comprising the roadside.

A discussion of the subject of management of roadside vegetation cannot go far without entering the realm of herbicides. On the 241-mile Ohio Turnpike over a period of five years we have developed a vegetation management program using chemical and mechanical methods which fit our needs reasonably well. During 1956 and 1957 guard-rail areas were mowed at a cost of \$17.50 per mile of guard rail per mowing. To accomplish a control pattern equivalent to that later obtained with herbicides, would require a minimum of three to five mowings

at a cost of \$52.50 to \$87.50 per year. Chemical control has cost \$43.00 per mile of guard rail per year, including the treatment of an average of 45 other post areas per mile. Herbicides used for this purpose, therefore, represent an advantage of at least \$9.50 per mile of guard rail, plus a dividend of clean areas around posts. An additional plus value attributable to spraying is the number of man-hours released for other more productive maintenance operations (an important consideration in an organization where the total labor complement is rigidly controlled).

About 10,000 delineator, milepost and signpost locations have also been treated with herbicide. There remain, of course, on some of these

locations the familiar "tufts" of unmowed clumps that resisted the herbicide and escaped the mower blades, but the overall control has been satisfactory.

Areas between the ditch line and the right-of-way fence are sprayed three times each growing season to prevent and eliminate broadleaf weeds. The total quantity of 2, 4-D applied per season per acre is 3 pounds of active ingredient. Weed control along highway rights of way in Ohio is required by statute and the Turnpike Commission is doing everything possible to maintain a high level of public relations with those whose properties adjoin our fence lines. Spraying costs for these areas are \$18.60 per acre and the average area per mile of right of way is 5 acres. Mowing, generally confined to the areas between the primary ditch lines, comprises an average of 7.5 acres per mile and costs \$13.50 per acre per year. The \$13.50 figure looks cheaper than the \$18.60, but it must be noted that mowing operations are limited to the median and areas between the outside shoulder and the primary ditch lines and performed with 5 and 7-gang reels. The irregular configuration of areas adjacent to the right of way fence would require different equipment and costs would be considerably higher.

Sections bordering woodland, swamps and other locations characterized by natural vegetation are neither mowed nor sprayed. It is expected that volunteer vegetation will become established in these locations and, with a minimum of maintenance, will develop into transition zones between the neatly mowed central areas and the native woodland growth.



● THIS IS a "non-turnpike" roadway showing weed and grass growth where neither mowing or other vegetation control measures were used regularly to control growth.



# Backhoe

## SOLVES INCINERATOR PROBLEM

New storage facilities, hydraulically operated charging gates and a backhoe to handle accumulated refuse have improved burning characteristics and eliminated time-wasting tieups of loaded refuse trucks at the Waltham, Mass. incinerator.

AS REFUSE collections increased, problems developed at the Waltham, Mass., incinerator. A line of refuse trucks waited to dump their loads on the floor of the incinerator building where a crawler tractor pushed it into one of the six holes feeding the furnace. For safety reasons, only one feed hole was uncovered at a time, reducing still more the rate of charging the furnace. Also, trucks were not permitted to dump if the floor were already filled, and no refuse was permitted on the floor overnight. Flashbacks from the furnace could ignite material not promptly stoked into the furnace.

Because of these factors, burning capacity was limited and, in some cases, combustible material was not completely burned. The cost was high because loaded refuse vehicles were held in line waiting for room to dump on the floor. Four men were needed for operation of the tractor, the charging and the clean-up.

Plans were developed for remodeling the incinerator, including the construction of two storage pits for the refuse. These were constructed to a width of  $14\frac{1}{2}$  ft., a length of  $27\frac{1}{2}$  ft. and a depth of 22 feet. The problem then arose of selecting equipment for handling the refuse—for taking it from the bins and feeding it into the furnaces, and also of mixing it in the bins to secure greater uniformity in moisture and burnability. Instead of the usual overhead rails and clamshell a Warner & Swasey Hopto hydraulic backhoe, slightly modified, was installed. This had to work within the limitations of the space between the ceiling beams and the lips of the charging hoppers, a vertical distance of 13 ft. The backhoe was slightly modified but is available for other uses, if desired, since it is not fixed in place. It was equipped with a standard pulpwood grapple and rotator and a modified telescoping stick. The telescopic action permitted the necessary reach within the re-



● ONE OF the receiving pits, left foreground, and one of the charging hoppers. Backhoe is located between two storage pits and the two hoppers, reaching all four.



● REFUSE trucks can dump their loads promptly on arrival at the plant. Waiting in line, with accompanying lost time, is no longer a problem at this rebuilt plant.



● **BACKHOE** was equipped with a standard pulpwood grapple for handling the refuse. Flexibility of the unit is such as to permit it to pick up refuse from the floor.

stricted vertical space limitations of the building.

The Hopto 500 was placed between the two storage pits; as rubbish is dumped into the pits, it loads into the furnace hoppers. The Hopto hydraulic downpressure digs deep into the rubbish for a full grapple load in every pass. The gates on the charging holes under the hoppers now operate hydraulically. The fast cycle—50 to 65 seconds from start of pickup in the storage pits to the time rubbish is dropped into the hoppers—fits perfectly into the new operation. This speed of feed, together with the advantages of storage facilities, have made the old line-up of trucks a thing of the past. Trucks now drive up to the incinerator, discharge their load and drive off.

Other advantages are apparent. Waltham's incinerator now takes a greater variety of materials because of the opportunity of drying-out in storage and because of the agitator action of the grapple and rotator. Leaves, sawdust, grass clippings, etc., now intermingle with paper in the storage pits. The action of the Hopto grapple and rotator stirs them up for further distribution. The result is a much better burn—far cleaner, with more thoroughly burned material than the previously matted refuse. This is much more satisfactory for disposal at the city's dumping areas.

Another advantage of the new system is the less frequent furnace cleanings necessary due to build-up

of improperly burned materials. This is in spite of the fact that the new incinerator setup permits burning 20 percent more per day. Automatic stoking, storage and improved feeding permits burning up to 100 tons a day; and the Hopto can stay ahead of the burning capacity of the two furnaces.

Previously, city-owned trucks had priority at the incinerator because the rubbish collection schedule had to be maintained. Now there is no long jam of trucks, no delays, not even for the commercial or institutional trucks.

### **Smaller Crew**

Only two men are now required in the operation instead of four. And now city management breathes more easily for these men are working in a safe area away from open furnace pits.

Waltham's new incinerator practices are a marked success. They have resulted in better burn, more control and no delays—as well as obtaining other efficiencies and safety advantages. The plant has been in operation for a full year without stoppage due to mechanical breakdown, and the Hopto was installed at a considerably lower cost than the conventional overhead method of feeding would have required.

Herbert F. Howe, director of Public Works for Waltham, was largely responsible for the rebuilding, with greater capacity and efficiency, of the incinerator. His experience with a city-owned Gradall led him to investigate the possibility of using standard construction equipment for feeding the furnaces, resulting in the installation described.

## **1 MGD SEA WATER CONVERSION PLANT**

A construction contract for a 1 MGD plant that will convert sea water to fresh water has been awarded by the U. S. Department of Interior's Office of Saline Water to the Westinghouse Electric Corporation. The plant will be located at Point Loma near San Diego, Calif., and its daily output of one million gallons of fresh water will be purchased by the city of San Diego.

Construction is scheduled for completion in one year. Once in operation, it will be the largest multi-stage flash-evaporator plant in the United States.

In awarding the contract, Dr. A. L. Miller, Director of the Office of Saline Water, pointed out that this will be one of five demonstration plants for processing sea or brackish water for agricultural, industrial and domestic uses. The plants will be designed and erected to demonstrate the reliability, and the engineering, operating and economic potentials for the various conversion processes.

The flash-evaporation process used in the San Diego plant will consist essentially of spraying heated sea water under pressure into a chamber that is at a lower pressure and temperature. A portion of the water "flashes" into vapor and is then condensed, providing water that is nearly free of impurities. The remaining salty water passes through a series of additional chambers where the flashing process is repeated.

The Westinghouse heat transfer department has a long record of experience in this field, including a large installation in Kuwait on the Arabian Peninsula where four multi-stage flash evaporation units now supply over 2.5 million gallons of drinking water a day from Persian Gulf sea water. The units in this plant have been in constant operation since 1957. With installations in numerous areas of the world, Westinghouse units are producing fresh water at a total rate of over six million gallons per day.

**PUBLIC WORKS for March, 1961**

- ◆ Is it legal for the urban utility to serve areas outside its boundaries?
- ◆ Is the urban utility obligated to serve such areas?
- ◆ Is it feasible for the urban utility to extend its services to such areas?
- ◆ Is it desirable that the urban utility extend its services to such areas?

## Administrative Policies for Utility Extensions

**JOHN B. POWERS**

*Formerly Engineering Representative,  
W. S. Dickey Clay Mfg. Co.*

*Mr. Powers is now Superintendent of  
the Texarkana Water and Sewage Sys-  
tems.*

THE ABOVE are questions which should be given careful consideration by both publicly and privately owned urban utilities as the first step toward planning sewer main or water service extensions outside the urban boundaries. This is particularly important in these inflationary times when utility rates and charges are lagging behind the cost of providing these services.

The legality of an extension plan depends primarily on local ordinances; or, if the utility is privately owned, on franchise restrictions. Certain limitations also may be imposed legally by holders of outstanding bonds or other obligations. And, of course, the utility must be financially able to extend its services.

Although a publicly owned utility generally is not obligated to service outside its boundaries, it does have certain obligations once it has extended its services to a suburban area. The outside area, for example, cannot be cut off or disconnected without due notice and reason; nor can the rates be raised indiscriminately. Once extensions have been made, they must be maintained and serviced just as if they were within the legal urban boundaries.

Before assuming these obligations, therefore, the utility should determine the financial return necessary to support investment and operating expenses. Even non-profit municipal operations may charge a reasonable amount for profit when serving outside the urban boundary. A realistic determination of rates beforehand generally will preclude any need to raise rates because of an inadequate return on investments.

In determining the feasibility of extending its services, the urban

utility must consider a number of factors. In the case of sewerage service, the utility must have ample facilities to treat the added sewage contributed by the outlying areas. An adequate collection system also must exist; if this is not adequate, careful consideration should be given to determine whether or not additional trunk mains can be constructed or extended at reasonable cost to provide the additional sewer capacity required to serve the area in question. In some localities, for instance, the topography would make such extensions too costly to be considered.

Only after a careful study of local conditions can the desirability of extending sewers outside the utilities boundaries be determined. It is important that consumers' needs and desires be correlated. The need may be there, for example, but when the sewer mains are extended, some residents may decide to continue to use their septic tanks. Therefore, only when the revenue from the operation will be commensurate with the cost involved should urban utilities extend their services.

It should also be remembered that the extension of utilities into outlying areas—whether within or outside the corporate city limits—often tends to accelerate decentralization trends within a city. Extension of utilities outside the city limits may slow the annexation of such areas to the city. However, since orderly development of outlying areas is necessary to the continued growth of the central city, extension is highly desirable to assure orderly growth.

Refusal by the urban utility to extend its services may lead to development of smaller suburban utilities which later may tend to discourage annexation more than would the extension of the urban system. If and when the area finally is annexed, the urban utility may be forced to buy out its competitor. In so doing, it may be required to take

over the latter's obligations which may have been based on ill-considered circumstances and unfavorable terms.

In agreeing to serve an independent suburban utility at wholesale rates, the urban utility should insist on a stipulation in the contract that it can acquire the independent utility on a reasonable basis if and when the suburb is annexed. In fact, a formula should be established for the purchase of the suburban utility in the event of annexation. Any such contract should define: Standards used in developing the urban utility system which should be met by the suburban utility; limits of the area served; amount of flow to be handled; length of time of the contract; and the urban utility's responsibility to serve in case of emergency.

Fundamental utility extension policies, equally applicable to areas within or outside the city limits, should be adopted if a successful extension program is to be inaugurated. These policies should be non-discriminatory and be based upon business principles. They should assure that the extension will be self-supporting, and should provide for customer participation in the financing of extensions if the anticipated revenue is insufficient to warrant making the extension. In addition, these policies should be implemented by the adoption of utility rules which should be reviewed from time to time.

In developing rules for implementing extension policies, it is advisable that the fundamental principles listed below be observed.

**Ownership of extension:** The title of ownership of an extension should always be vested in the utility.

**Further extension:** The utility should reserve the right to make still further extensions beyond or laterally from the extension being paid for; this should not be considered as an additional connection to the extension, and should not en-



title the original promoter to a refund.

**Piping:** The utility should always determine the size and type of pipe for the extension, and the details of installing.

**Utility investment:** The amount of investment to be made by the utility in suburban extensions should be specified. This should be based on the amount of the revenue to be derived from the extension and depend on the investment that the utility can afford to make toward the cost of extension.

This amount can be determined by the Norris formula (3) which is based on the anticipated revenue, operation ratio (the percentage of the gross operating earnings expended for operation and maintenance), ratio of pipeline to total investment, and proper rate of return.

In developing extension practices it should be provided that, when the cost of the required extension exceeds the amount which the utility is justified in investing in a "free" extension, the customers shall deposit the difference with the utility as "an advance in aid of construction" or as a "contribution in aid of construction."

When customers make an advance in aid of construction, subsequent customers may become "free riders." This makes the original contributors unhappy. For this reason, some utilities collect frontage fees or connection charges from subsequent customers to assist in the refund of the original customer's deposit.

Deposits are repaid only until the refund period has elapsed. The refund rule should provide that, if the entire advance is refunded before the expiration of the contract period, no further refunds will be made. It must be remembered that it is almost impossible to inaugurate an extension or refund plan which is absolutely equitable in every case.

In computing refunds on a revenue basis, the differential charges levied upon customers outside city limits to compensate the utility for the added cost of serving them, should not be considered revenue.

#### References

1. "Water Main Extension Policy," Report of Committee, *Journal AWWA*, August, 1949.
2. "Water Service for Suburban Areas," Committee Progress Report, *Journal AWWA*, July, 1953.
3. Norris, A. O., "Financing Distribution System Extensions," *Journal AWWA*, January, 1949.
4. Steel, E. W., "Main Extension Policies for City-Owned Water Works," *Southwest Water Works Journal*, May, 1960.

# GOVERNMENTAL REGULATIONS AND THE COST OF SEWAGE TREATMENT

HALVOR O. HALVORSON

Professor of Microbiology, University of Illinois

AT A RECENT meeting of the Central States Sanitary Engineers, an agreement was reached that stated "henceforth in the design of trickling filters the maximum allowable loading is 50 pounds of five day BOD per 1000 cubic feet of filter media." This has been the policy in the State of Wisconsin for some time. In discussing this with the Engineers of the Division of Sanitation at the State Board of Health in Wisconsin, we learned the reason is a belief that a higher loading will result in disagreeable odors. However, they agree that higher loadings can, and often do, give satisfactory results as far as percentage removal is concerned.

Since this arbitrary ruling does substantially increase the cost of sewage treatment, particularly where two-stage treatment is necessary, we need to question the cause of these possible unnecessary bad odors. Organic matter gives off foul odors only when decomposed under anaerobic conditions; thus, trickling filters that give rise to bad odors must be anaerobic. The cause of this is quite obviously insufficient aeration. There are a number of factors that can lead to insufficient aeration; since each of these warrant some consideration, I shall discuss them under the following classifications: 1) Poorly designed underdrains that do not permit sufficient aeration; 2) filter media which is undersized and not uniform; and 3) internal local clogging or ponding.

#### Improper Underdrains

These are not a common cause of anaerobiosis, but in instances it does occur. I had occasion to visit various trickling filter plants in Europe, a few years ago, where the operators had complained about poor results and bad odors. In one, I found the

settling tank had been built at such a level that water coming from the filter backed up into the underdrains and prevented proper aeration. This was a good demonstration of the conclusions reached, a number of years ago, by Dr. Max Levine, that if the air supply to a filter is shut off, the filter becomes not only anaerobic but also clogged with organic matter in the interspaces between the members of the media (1). This further blocks the flow of air. When the water level in the final tank of this plant was corrected, the filter began to function normally without disagreeable odors and produced the kind of results expected.

#### Improper Filter Media

In the early experiments at Lawrence, Massachusetts (2), the effect of size and uniformity of filter media was studied in considerable detail. In a number of experimental filters constructed with media varying from fine sand to very coarse rock and cinders, it was found (and verified many times since) that fine media will clog with relatively low organic loads and produce anaerobic conditions with odors. Since the time of this experiment, many successful plants have been built where uniform coarse rock or prefabricated

---

*A new regulation adopted by the Central States reduces the permissible loading on trickling filters for sewage treatment. The author, who last June received a special commendation for outstanding achievement from the University of Minnesota, takes the viewpoint that these restrictions are unjustified and will increase the cost of construction of trickling filters without compensating benefit.—Ed.*

---



cated media have been used and where loading is considerably above 50 pounds per 1000 cubic feet. These plants have functioned well without obnoxious odors. A number of examples can be cited, such as the plants at Owatonna, Minnesota; Esterbrook, Iowa; and Cumberland, Wisconsin. Examples can also be cited of plants where the filters are anaerobic but I feel it is not necessary to mention these by name here, because anyone who has visited a number of trickling filter plants will remember seeing such examples. In many cases the cause may not be too obvious. This point I can best illustrate by these following examples:

During a visit to Norway three years ago I was asked to visit one particular plant where the filter was giving very poor results. At first it was not obvious to me what was wrong. The rock size at the surface was from 1½ to 3 inches in diameter and there did not seem to be any flat pieces. I concluded there must be something wrong down in the filter and suggested to the engineer that the media should be removed and examined before constructing additional filters. When this was done, they found that the bottom one foot of media was fine gravel rather than rock. No one knew why this had been done. When the media was replaced with well graded and properly sized rock, the filter began to function normally and has done so well that there has been no need to construct additional filters.

I will cite another of my experiences that has a bearing on this point. Some years ago, I was the responsible engineer for the design and construction of a trickling filter plant in Minnesota. One day, before the inspector arrived on the job, the contractor began to place the media into the filter and had dumped a fairly large quantity of small rock (almost gravel) into the bottom of the filter. He had begun to cover this with properly sized media when I arrived on the scene. I insisted the contractor take all this fine media out and replace it with media graded according to specifications. If this had not been done I am certain we would have had a filter that functioned no better than the one I mentioned in Norway. I suspect improper filter media is the underlying cause of failure in trickling filters in most of the sewage plants which are not functioning properly.

#### Internal Clogging

Bad odors can result if the media is clogged in certain local areas,



● TWO STAGE high rate trickling filter plant at Bryan, Texas, was built in 1949 and is still providing an overall BOD reduction of around 90 percent, with effluent values ranging from 18 to 27 mg/L, in spite of a fifteen percent overload from the design figure. These filters are equipped for rain-like or low momentary distribution; each contains 0.61 acre foot of limestone quartz media, 3 to 6-in. size range.

even though the filter as a whole may continue to give reasonably good reductions. This clogging is not easy to detect because it may be deep enough in the filter to be obscure. In fact, the surface may look quite normal but a bad odor coming from such a filter must in itself be proof that certain areas within the filter are anaerobic. This will not happen if proper aeration prevails throughout. It can be caused by the dumping of improperly graded media in some areas. Where adequate inspection is not exercised, this might be willfully done by a contractor to save money. It can also happen unintentionally by breaking or crushing some of the material during hauling and handling. The best way to overcome the difficulty is to screen the media at the construction site; another way is to use prefabricated media in which the sizing and voids are under perfect control.

It should be obvious from the above statements and other common knowledge among competent engineers, that filters having the proper media will not become anaerobic except at very heavy loadings—much above 50 pounds of 5-day BOD per 1000 cubic feet of media. It is my opinion that State Sanitary Engineers are doing the tax payers a great injustice by substituting arbitrary rules for adequate specifications and inspections. This agreement that has recently been accepted by the Central States Sanitary Engineers is particularly unfortunate where roughing filters are indicated for pretreatment.

The selection of proper media does not in itself insure maximum removals. The factors that influence the flow of air through the filter are not in themselves the basic factors that control the degree of purification. The latter is dependent upon uniformity of dosage and to only a limited extent upon the rate of liquid dosage (3). In the early publications following the development of the high capacity filters this was stressed and the importance of proper distribution on such filters has been amply demonstrated in the intervening years. This fact was recognized in the earlier Joint Statement of the Central States Sanitary Engineers when the importance of low momentary rates was stressed. If this regulation is enforced, high capacity filters will continue to give the high removals shown in the Walton reports. With low momentary rates obtained with a rain-like distribution, removals are substantially the same for liquid dosages from 10 to 30 million gallons per day.

#### References

1. Levine, M. and Goresline, H. E., "Effect of Bottom Ventilation on Purification by an Experimental Trickling Filter," Iowa State College of Agriculture and Mechanical Arts. Bul. 116, Vol. 32, April 11, 1934.
2. Annual Reports of the State Board of Health of Massachusetts, 1891: 425-600; 1901: 271-321; 1902: 179-223.
3. Childs, J. A. and Schroepfer, G., "Trickling Filter Loadings," Civil Engineering, 1: 1391-1393 (1931).
4. Halvorson, H. O., "Aerofiltration of Sewage and Industrial Wastes," Water Works and Sewage, 83: 307-313 (1936).



First step—spot the post hole digger and let the dirt fly. Stress-Spun standards, with butt foundation, eliminate the need for costly, troublesome cast-in-field foundations.



Next, pick up the Hy-Lite pole with a rope sling and set in the hole. Any pole line truck or crane will handle the job with ease. Then align the pole in a vertical position.



Finally, backfill around the butt foundation with fine crushed stone. Wet, then tamp. Total setting time—14 minutes...ready for all electrical work.

# SET IN LESS THAN 15 MINUTES



Finished Hy-Lite installation—attractive appearance and daylight safety around the clock.

The easy, low cost DRILL, SET, TAMP method of installation helps make Hy-Lites your best lighting pole buy.

Take time to request Catalog No. 400. It will give you details on the wide range of attractive Hy-Lite designs and the many plus advantages of prestressed concrete standards. Address the American Concrete Corporation, 5092 North Kimberly Avenue, Chicago 30, Illinois.

**American Concrete**  
STRESS-SPUN  
HY-LITE  
LIGHTING STANDARDS



## NEWS BULLETINS

AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

### APWA's Street Maintenance Committee Conducts Comprehensive Survey

The Street Maintenance Committee of the American Public Works Association is working on the preparation of an authoritative manual on street maintenance practice in urban areas. The Committee has recently completed a comprehensive 25-page questionnaire on the administrative and technical aspects of street maintenance.

This questionnaire has been mailed to selected governmental agencies in the United States and Canada. The results will be utilized in the writing of a manual which is expected to be one of the most important publications in this field.

Ladis H. Csanyi, professor in charge, Bituminous Research Laboratory, Iowa State University, Iowa, and T. R. Jacobi, Field Services Representative, Public Administration Service, Chicago, Ill., have been retained by the Association as special consultants to work on this project.

The work of the committee is being directed by Edward J. Booth, city engineer, Bismarck, N. D., chairman. Other members include: C. M. Thelin, director of public works, Fort Worth, Texas; Randolph M. Martin, city engineer, Vancouver, British Columbia, Canada; David K. Speer, road commissioner, San Diego County, San Diego, Calif.; and Hunter Jones, chief of maintenance, Richmond, Va.

### Bodien Chairman of 1961 Congress and Equipment Show

APWA's President Frederick W. Crane recently named Gordon E. Bodien, city engineer, Minneapolis, Minn., as Chairman of the Local Committee for the Association's 1961 Public Works Congress and Equipment Show. The annual meet-



Gordon E. Bodien

ing will be held in Minneapolis Sept. 24-27. It is expected to attract over 3,000 public works officials and more than 100 exhibitors. The Leamington, the headquarters hotel, is a short distance from the Municipal Auditorium where the technical sessions and exhibits will be held. Exhibit brochures will be mailed soon. Meantime information is available from the Association.

APWA's Public Works Congress and Equipment Show serves the entire public works field by bring-

ing together "key" officials from all parts of the United States and Canada to exchange views on public works problems and to see and learn more about the latest types of equipment, materials and supplies that are being developed. The exposition also gives manufacturers and suppliers an opportunity to keep informed of the happenings in this billion dollar public works market. Mr. Bodien is city engineer for Minneapolis. Previously he was with the Minnesota Highway Department.

Future issues of PUBLIC WORKS Magazine will give more information about the 1961 meeting.

### APWA Repeats Sponsorship of National Public Works Week

The Board of Directors of the American Public Works Association, meeting in Chicago January 27th for a mid-winter meeting, authorized the appointment of a public relations committee to lay plans for the observance of National Public Works Week and related activities again this year. An announcement of the committee members will be made in the near future. The program for 1961 will again include the selection of the Top Ten Public Works Men-of-the-Year.

The program was launched for the first time in 1960 in an attempt to foster a better understanding of the function and importance of public works in the community, to enhance the professional status of public works officials in government, and

OFFICERS: Frederick W. Crane, Buffalo, N. Y., President; Albert G. Wyler, New Orleans, La., Vice President. REGIONAL DIRECTORS: (term ending 1961) Louis H. Moehr, Wyandotte, Mich.; John A. Morin, Oakland, Calif.; Roy W. Morse, Seattle, Wash.; (term ending 1962) Paul R. Screvane, New York, N. Y.; Manon P. Phillips, Augusta, Ga.; Edward J. Booth, Bismarck, N. D.; (term ending 1963) George J. Maher, Lewiston, Maine; Robert S. Hopson, Richmond, Va.; Harlan H. Hester, Fort Worth, Texas. Immediate Past President, Jean L. Vincenz, San Diego, California. Robert D. Bugher, Executive Director.



# SAVED: 203 MAN-HOURS PER DAY WITH THE LOAD-PACKER 600



**POINTING WITH PRIDE** at one of his fleet of seven Load-Packer 600's, and his humorous slogan, "Satisfaction Guaranteed or Double Your Trash Back," is Tom Dailey, owner of Dailey Sanitary Service, Overland Park, Kansas.

## LARGE, LOW HOPPER CUTS PACKING CYCLES, SPEEDS COLLECTION

The big 1½-yard, 74-inch wide hopper of the Load-Packer 600 allows fewer packing cycles. This time-saving, money-saving feature is particularly important for collectors with commercial pick-ups.

The big hopper allows crews to work faster. It allows substantial savings in fuel costs, because the number of packing cycles are reduced. It materially helps prolong the life of the engine, packer pump, power take-off, and drive line.

The low loading height of this hopper, 4 inches below the chassis frame, makes the crew's job far



easier and far more efficient. And the width of the hopper allows three men to work side by side with no overhead restrictions.

## Kansas Collector Cuts Workday in Half by Switching to Gar Wood

In Overland Park, Kansas, the Dailey Sanitary Service has replaced 12 collection units with seven Gar Wood Load-Packers. The result: Crews reduced from 22 men to 15, their workday cut from 14 hours to seven, total man-hours cut from 308 to 105 per day, and a great reduction in maintenance costs.

Tom Dailey attributes this remarkable efficiency to the fast action and powerful compaction of his 18-yard Gar Wood units. Since his collection route is large (14,000 homes, 75 commercial pick-ups), speed of operation is of vital importance. A crew can reload a hopper in just 4 seconds, and its full packing cycle takes only 10 seconds.

Economy was also a big factor in Dailey's switch to Gar Wood. Because of the Load-Packer's fast packing cycle, the truck engine runs fast only about half as long on each cycle as other machines, saving both fuel and wear and tear on packer, engine and chassis. And because of the size of the Load-Packer's hopper, fewer packing cycles are required on any given route.

Like Tom Dailey, more and more refuse collectors are finding that the speed, compaction, and big, wide hopper of the Load-Packer 600 save time, money and manpower.

## GAR WOOD INDUSTRIES, INC.

Wayne, Michigan  
Richmond, California



to help attract competent personnel to the field.

In a report to the Board, Executive Director Robert D. Bugher pointed out that one of the most significant developments during the year was the large increase in the number of Sustaining members. A total of fifteen new firms took out this type of membership during the year making a total of 47 companies now holding this type of membership. Mr. Bugher also reported a steady growth in membership over the calendar year for 1960 showing a net increase of 517 members, the largest in any one year in the history of the Association. This brings the total membership of the APWA to 5077. The number of cities holding public agency membership has now climbed to 288.

The Board was informed that the Street Sanitation Committee has taken steps to have a training film prepared on the proper adjustment of street sweeping machine brushes. Arrangements have been made for the fiber producers to underwrite the cost of the film which is estimated at approximately \$5,000. The Committee plans to work with the Film Institute of the City College of New York which will produce the 20-minute sound motion picture in color.

Regarding the 1961 Public Works Congress and Equipment Show to be held in Minneapolis, September 24-27, the Board approved a tentative program which calls for an "early bird" registration at the Leamington Hotel from 9 a.m. to 11:00 a.m. Sunday morning, Sept. 24. Registration will continue through the afternoon along with an opportunity to review exhibits. The Congress will officially open Monday morning at 10:00 a.m. Clinics will again be a part of the Congress which will extend through Wednesday, Sept. 27.

Board members in attendance were: Frederick W. Crane, general manager, Buffalo Sewer Authority, Buffalo, N.Y., president of the APWA; Albert S. Wyler, director of streets, New Orleans, La., vice-president; Robert S. Hopson, director of public works, Richmond, Va.; Manon P. Phillips, commissioner of public works and city engineer, Augusta, Ga.; Louis H. Moehr, city engineer, Wyandotte, Michigan; Edward J. Booth, city engineer, Bismarck, N. D.; H. H. Hester, street superintendent, Fort Worth, Texas; Roy Morse, city engineer, Seattle, Wash.; and Jean L. Vincenz, director of public works, County of San Diego, Calif., immediate past president.

Other Board actions are reported in the APWA News Letter which is distributed to all members as a regular service of the Association.

### Environmental Engineering and Metropolitan Planning: A Spring Conference

The American Public Works Association in cooperation with other public service organizations will assist in the sponsoring of a conference on "Environmental Engineering and Metropolitan Planning" to be held March 21 and 22. The conference will be held at the Technological Institute at Northwestern University in Evanston, Ill. Robert Anderson, superintendent of public works and village engineer, Winnetka, Ill., has been designated as the Association's liaison representative to work with the planning committee in preparation for the meeting. Conference Chairman is Dr. John Logan, chairman, Department of Civil Engineering, Northwestern Technological Institute.



Mr. Anderson

The meeting is being set up to serve as a working session for civil engineers, city planners, public health specialists and governmental officials. It is being sponsored by the Northeastern Illinois Metropolitan Area Planning Commission, the Technological Institute of Northwestern University, and the Public Health Service, in cooperation with the APWA, American Institute of Planners, American Society of Civil Engineers (Planning and Sanitary Engineering Divisions), and the American Society of Planning Officials.

One of the objectives of the conference is to establish a more effective and intimate working relationship between civil engineers and planners.

### 12-Week Training Course Sponsored by Chicago Chapter

A new in-service training course for public works construction inspectors is presently being sponsored by the Chicago Chapter of the APWA. The first session was held February 9, with classes meeting every Thursday from 1:30 to 4:30 p.m. for twelve weekly sessions, at Northwestern University, Evanston, Ill.

# NEW! EVANS Wedge-Lock\*

TYPE "O" JOINT

SEALS VITRIFIED PIPE

FASTER, TIGHTER THAN EVER BEFORE!

Available now on large diameter Vitrified Pipe, Evans' new Type "O" Joint provides the same tight seal and minimum infiltration characteristics as the double-ball Wedge-Lock Joint.

Cut-a-way view shows points of compression.

Evans Type "O" Compression Joints are permanently bonded to the pipe to provide a tighter, longer-lasting seal.

Rubber gasket ring slips over spigot joint... helps create uniform high compression around the entire circumference of the pipe.

\*Pat., T.M. Reg., U.S. Pat. Off.

### COMPLETE LINE OF VITRIFIED PIPE AND MATCHED FITTINGS

- Double Length — Twice as Long as Ordinary Pipe
- Conventional Bell-and-Spigot
- Wedge-Lock Factory-Made Compression Joints
- Die-Cast Factory-Made Bituminous Joints

One of the nation's largest producers of Face Brick, Clay Pipe, Flue Lining, Wall Coping, Plastic Pipe, and related construction materials, known for over 50 years for faster, friendlier service.

THE  
**EVANS**  
PIPE COMPANY

GENERAL OFFICES, UHRICHSVILLE, OHIO  
TELEPHONE Walnut 2-4210

E 360-7

Using a very broad approach, this practical course of study is especially designed for the men who actually do the inspection work and for those who direct such activities. Its purpose is to acquaint the participants with the importance of the inspector's job; the basic field procedures to be followed and records to be kept; and modern methods of testing compliance with specifications that are commonly used in this area. Group discussions will follow each presentation. Examinations will be given and a certificate will be awarded to those who successfully complete the course.

An outline for the twelve sessions includes: (1) Contract Documents, Plans, and Specifications, (2) Inspection Procedures and Records, (3) Soils and Subgrades, (4) Asphalt Paving—Part I, (5) Asphalt Paving—Part II, (6) Concrete Paving—Part I, (7) Field Trip, (8) Concrete Paving—Part II, (9) Water Mains, Sewers and Appurtenances—Part I, (10) Water Mains, Sewers and Appurtenances—Part II, (11) Summary and Examination, (12) Presentation of Certificates and a special luncheon.

Over 100 persons engaged in public works in the Chicago area have

signed up for the course including city officials, military personnel, consulting engineers and utility employees.

• • •

### Plastic Markings For Railroad Crossings

A major program of marking dangerous railroad grade crossings in Ohio with permanent-type white, reflectorized Plastix "RR" legends and "Stop" bars has been inaugurated by the Department of Highways following successful test applications of the new legends at two crossings. The announcement was made by James V. Musick, Traffic Engineer, and William H. McLaughlin, Technician of the Traffic Engineering Department.

Initial attention will be concentrated on installing the Plastix legends at 110 grade crossings with bad accident histories, officials of the Highway Department's Bureau of Traffic said. In addition to protection of the two crossings, the Department has installed a total of 28 "Turn" arrows and 22 "Stop" bars at eleven busy intersections.

The special railroad crossing legends are applied directly to the pavement, in the right lane. Distance from legend to railroad tracks is determined by a special formula, as is the placement of a "Stop" bar, also of Plastix, located between the legend and the tracks.

The special program for grade-crossing protection was developed as the result of legislation enacted by the 102nd General Assembly of the Ohio Legislature, and a report submitted to the legislature in 1959. The report, based on extensive study, set forth that Ohio has 10,852 grade crossings of public highways, of which 2,752 were protected and 8,100 were unprotected. The crossings accommodated 13,731,830 vehicular crossings and 138,536 train crossings per average week day.

The survey also pointed out that the greatest returns in increased safety for dollar volume of investment could be realized in the fields of warning devices and improved sight distances.

Use of the permanent-type Plastix for legends and stop bars has been recommended in view of the long life of the material, which stands up under traffic and weather for years. Coated with a special adhesive, the Plastix adheres immediately to the surface of the highway, and under traffic quickly becomes almost an integral part of the pavement, with little wear under cinders, salt and even snow plows.

## STANDARD STEEL "S-J" Maintenance Distributor



for **VERSATILITY — EFFICIENCY — ECONOMY**



**HANDLES ASPHALT OR  
TAR—FOR PATCHING—  
SEALING—RESURFACING—  
CRACK FILLING—  
OR SURFACING DIRT  
OR GRAVEL ROADS**

### WORKS FAST—FAR AHEAD OF THE GRAVEL GANG

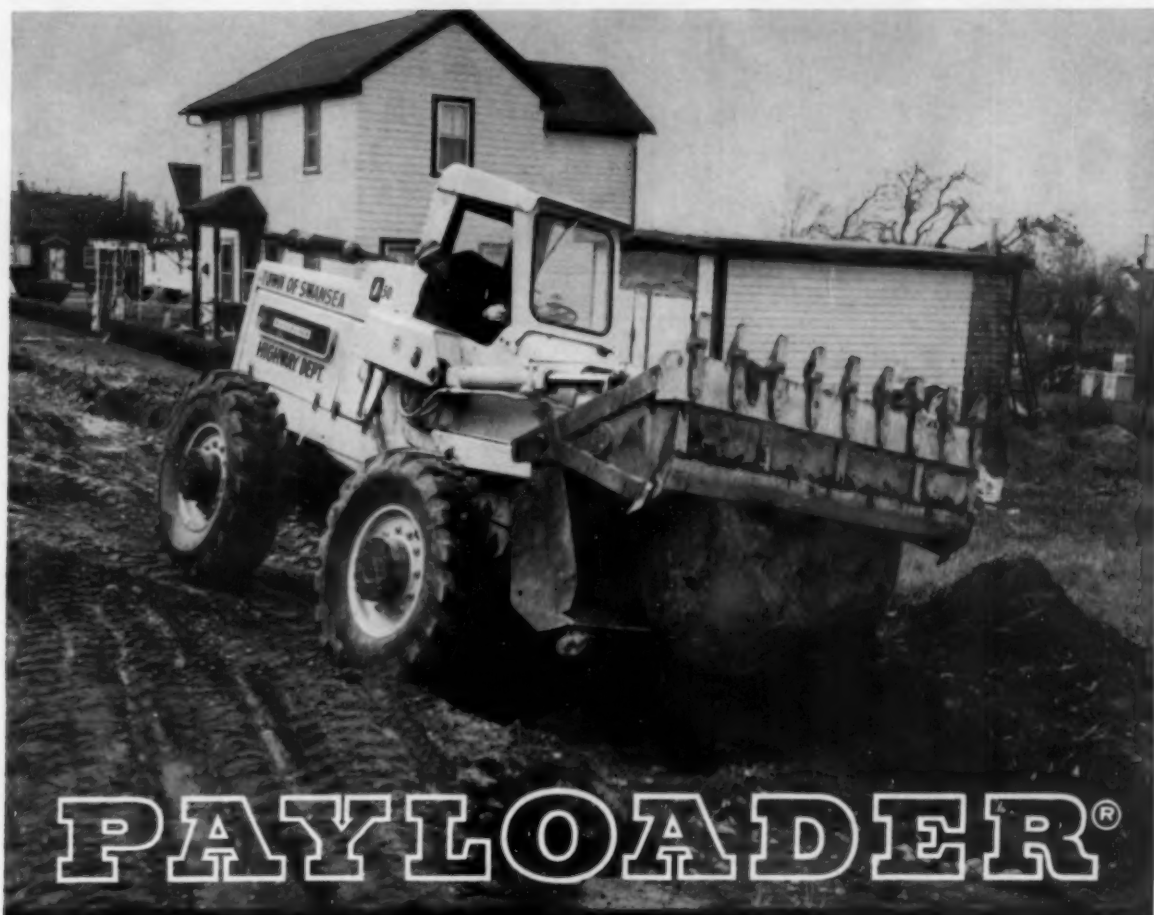
Standard Steel S-J Maintenance Distributor, designed specifically for jobs where the use of bigger equipment is costly and impractical, can be moved rapidly from one location to another for patching, shoulder repair or construction of secondary roads. . . . It is equipped with suck back spray bar which permits closing of the discharge valve and pulling back all surplus material in the spray bar and piping for quick cleaning. . . . All piping and valves are flanged to permit easy repair or replacement. . . . The draw off valve is on curb side for safety. . . . and coiless self-generating burners are standard equipment as well as a Viking special asphalt pump which can be completely drained, eliminating the necessity for thawing when the unit is started cold. Write for complete details on Model S-J.

**OTHER PRODUCTS OF STANDARD STEEL**  
ASPHALT DISTRIBUTORS . . . BURNERS . . . POWER AND TRAC-  
TION DRIVEN CONSTRUCTION BROOMS . . . MAINTENANCE  
DISTRIBUTORS . . . TAR KETTLES . . . AGGREGATE SPREADERS  
STREET FLUSHERS . . . PIPE LINE EQUIPMENT . . . SUPPLY TANKS  
SHELVEING HARDWARE . . . AND AGRICULTURAL EQUIPMENT



**Standard Steel Works, Inc.**, NORTH KANSAS CITY, MO.

S 77



## Can your tractor-shovel do this?

*"The H-50 PAYLOADER with 4-in-1 versatility really pays", says R. S. Macomber, Supt. of Streets of Swansea, Mass. "After recent hurricane 'Donna' visited us the clean-up action of the '4-in-1' bucket quickly paid for its extra cost over the straight bucket. The ability to pick up and load large objects fast and efficiently without extra labor—such as debris, downed trees and stumps—meant a major saving in time and labor costs. We are also experiencing very good production and service on our regular work. It's the best all-around loader that I have ever used."*

You can't beat a tractor-shovel for public work and you can't buy a tractor-shovel that pays off like a PAYLOADER. Its proven stamina and mechanical superiority plus the exclusive Drott "4-in-1" offered with it saves the taxpayers money all year 'round.

The Town of Swansea's experience with the Model H-50 equipped with Drott "4-in-1" bucket is but one example. Various PAYLOADER sizes and other allied equipment are helping many public works departments get more mileage out of each tax dollar.

Whatever your requirements there is a PAYLOADER size and type to match it—plus a wide choice of allied equipment, including: hydraulic back-hoe; side-boom; pick-up sweeper; "4-in-1" bucket; earth auger; black-top spreader; vibratory compactor; all types of snow plows. Your Hough Distributor is ready to show you why you and your public get more for your money when you invest in a PAYLOADER. See him today.

# HOUGH®



THE FRANK G. HOUGH CO.

LIBERTYVILLE, ILLINOIS

SUBSIDIARY - INTERNATIONAL HARVESTER COMPANY

HOUGH, PAYLOADER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.

THE FRANK G. HOUGH CO., 761 Sunnyside Ave., Libertyville, Ill. 3-B-6

NAME \_\_\_\_\_

TITLE \_\_\_\_\_

GOVT'L UNIT \_\_\_\_\_

STREET \_\_\_\_\_

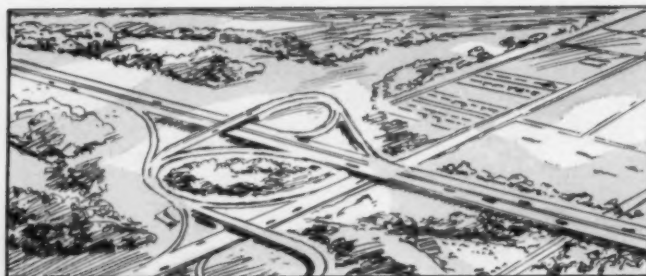
CITY \_\_\_\_\_

STATE \_\_\_\_\_

Send "More mileage for your tax dollar".



# THE HIGHWAY AND AIRPORT DIGEST



Prepared by L. G. BYRD, Associate Editor

## Road Improvement Priority Ratings

Facts most needed in deciding what road improvements should be undertaken first can be classified as those reflecting the importance of the road. A method developed for use of towns and counties in New York State had, as its objectives, a system that was simple, valid, objective and understandable. The method was centered on the two questions—importance and condition of the road. Two ratings, an Importance Rating and a Condition Rating were developed and combined to give a Priority Rating. The Importance Rating weighed traffic service and community service. The Condition Rating compared actual measurements with geometric standards. The elements emphasized the basic factors of adequate widths, good alignment and grade, and structural adequacy. The Condition Rating was intended to reflect a relative need for reconstruction or basic improvements beyond routine surface maintenance.

"Priorities for Road Improvement." By J. W. Spencer, Highway Research and Extension Engineer, Department of Agricultural Engineering, Cornell University, Ithaca, N. Y. *Rural Roads*, January, 1961.

## Traffic Safety On County Roads

County roads in Indiana have shown an increase of from 10 percent of the state's traffic death total twenty years ago to 20 percent of the total today. The increase was caused in part by increases in motor vehicle registrations; increases in miles driven per vehicle; spilling over of state and city highway traffic onto the county system; population migration to suburban areas; improved county road surfaces without improved geometrics or safety markings; and reluctance of some county officials to attack the

problem properly and forcefully. The fact that the state traffic death rate decreased from 17.1 to 5.9 deaths per 100 million miles of travel over a twenty year period indicates that counties need to study and adopt methods now used in safety promotion on state highways. While the \$522 per mile per year available for work on the average county road is inadequate for the high standards desired, the most efficient use must be made of these funds for the protection of life on county highways.

"How Can Counties Develop an

Adequate Traffic Safety Program?" By the late Hallie L. Myers, formerly Executive Director, Indiana Traffic Safety Foundation, Inc., Indianapolis, Indiana. *Highway Extension News*, October, 1960.

## Small Car Parking

The Los Angeles City Council asked its Department of Traffic to investigate the effects of the small cars on parking facilities within the city. The investigation indicated that eighteen-foot stalls located in pairs

## Hollywood Boulevard Gets Special Luminaires

**S**TAR-STUDDED lighting fixtures make Hollywood Boulevard in Hollywood, California, the brightest it has ever been. Over 150 special luminaires, designed and built by the Westinghouse Electric Corporation, provided a light level of over 10 footcandles. Each fixture contains three 700-watt "Colortone" deluxe white mercury lamps which create light complimentary to most complexions and decorative patterns. This is accomplished through use of both a phosphor coating on the lamp bulb and a special filter glass. Each lamp has a rated economic life of 10,000 hours, or about 2½ years.

The new lights provide an after-dark canopy highlighting the "Walk of Fame," 15,000 lineal feet of terrazo sidewalk containing the names and symbols of 1200 stars from radio, television, recording and motion pictures. Five coral-colored stars line each side of all the luminaires.

The Pacific Union Metal Company supplied the light pole extensions and supports for the luminaires. The standards have outlets to provide for plug-ins for seasonal or premiere lighting without stringing

special wiring from pole to pole. The Newberry Electric Corporation, Los Angeles, installed the lights under the direction of O. W. Meissner, director of the bureau of street lighting, City of Los Angeles.







## Digs rock...lays pipe...backfills

*In 25 hours, Michigan handles entire 650 ft sewer job for City of Columbia*

"In the two seasons we've owned our Michigan Model 55A Tractor Shovel, we've used it economically—and successfully—on just about every maintenance-type job you can imagine," reports Public Works Director Morris Thurman, Columbia, Tennessee. "It's dug ditches and pipe lines... truck-loaded dirt, gravel, asphalt and other bulk materials... ripped old paving... spread bituminous material for street repair... graded and leveled."

An example of one of the Michigan's more dramatic assignments was the recent laying of a 10-inch sewer line in 90% rock. Equipped with a Michigan Snap-Mount Backhoe, the 66 hp Tractor Shovel *did the entire job by itself.*

First the Michigan used its 1 yd tractor shovel excavating bucket to scrape away surface material so the rock ledge could be drilled and shot. Next came trench excavation, the Michigan backhoe digging out both shot rock and adjacent hard-packed clay. Then, using the hoe's 180° swing boom, the Tractor Shovel assisted workmen in hoisting and laying the concrete pipe. Next came backfilling and soon, with the machine's big tires rolling over the

loose material, the desired compaction. In all, only 25 work hours had elapsed—yet the 650 ft long, 5 ft deep line was completed.

### "Backhoe on or off in a minute"

"One of the best features of the Michigan is this versatility," says Mr. Thurman. "We also like its mobility... plus the fact that one man can attach or detach the backhoe in *less than a minute... without tools.* This permits the Michigan to work on other jobs right up to the minute we need the backhoe. For example, it truckloads stockpiled asphalt, a one yard bucket-full every 20 seconds." And, with power steer, hydraulic brakes, horn, lights, parking brake, torque converter and power shift transmission (standard equipment on all Michigans), this Tractor Shovel has proved easy and safe to operate everywhere.

Investigate the 26 mph, 1 yd Model 55A for yourself. It's designed especially for city work—and city budgets. It has good digging power and a wide variety of attachments. Your Michigan Distributor will be glad to demonstrate one on your job—or to show you any

of the larger Michigan Tractor Shovels (buckets up to 12 cubic yards).



### Michigan Snap-Mount Backhoe

Can be attached (or detached) by one man in 30 seconds... without tools. Digs 12'4" deep, 12" to 36" wide. Can be combined with wide variety of quickly-interchangeable front-end attachments: sprinkler-type pick-up sweeper; crane hook; fork lift; scarifier; blower, "V", straight snow plows; broad range of buckets.

Michigan is a registered trademark of  
**CLARK EQUIPMENT COMPANY**  
Construction Machinery Division

**CLARK**  
EQUIPMENT

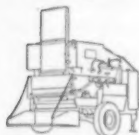
2499 Pipestone Road  
Boston Harbor 7, Michigan  
in Canada:  
Canadian Clark Ltd.  
St. Thomas, Ontario



## Solve Your Patching and Repairing Problems with *McConnaughay* HTD MIXERS

### NO OTHER MIXER CAN DO ALL THESE THINGS

You can use a McConnaughay Mixer to reactivate and heat stock pile mixtures... prepare cold asphaltic mixtures... prepare hot asphaltic mixtures... dry various types of wet aggregates quickly, thoroughly... remove *both* moisture and solvents from bituminous mixtures... produce bituminous mixtures with tars, paving asphalts, cut-back asphalts, and emulsified asphalts. McConnaughay Mixers operating under U. S. Patent No. 2,626,875, are authorized to mix emulsified asphalt and aggregates in the presence of flame and heated gases. Write for our folder on the complete line of McConnaughay Asphalt Patching Mixers as well as for specifications and proportioning tables.



HTD MIXER No. 10  
1/2 ton per batch



HTD MIXER No. 8  
1/2 ton per batch



HTD MIXER No. 5  
1/4 ton per batch



HTD MIXER No. 4-T  
1 1/2 ton per batch

### McCONNAUGHAY MIXERS, INC.—LAFAYETTE, IND.

National distributors: Asphalt Equipment Co.

3314 Cherry Lane, Fort Wayne, Indiana

Export Representative: William H. Schuelie, 440 E. 79th St., New York 21, N. Y.

separated by 8-foot red zones are the minimum standards which could be adopted without adversely affecting a large number of cars. There would be a net gain of 25 spaces in the Civic Center Parking Meter Zone if 18-foot stalls were used. This amounts to a 5.1 percent increase in on-street parking capacity and a 0.33 percent increase in total Civic Center parking capacity. To achieve this increase in capacity would require the removal and relocation of 190 parking meters, 380 stall markings and about 90 red zones. Currently 7.6 percent of the automobiles registered in California would be too long to fit into 18-foot parking stalls and an additional 36.1 percent would be subjected to unusual difficulty in legally positioning a vehicle within the stall markings. By 1965 these estimates would decrease to 6.4 percent and 30.5 percent respectively due to the increasing number of compacts. It is unlikely that a reduction below 18 feet would be feasible without undue hardship to about one-third of the vehicles operating on the streets within the next ten years as relates to on-street parking stalls.

"Small Car Parking." By Salem Spitz and Stephen Edwin Rowe, Department of Traffic, Los Angeles, Calif. *Traffic Engineering*, January, 1961.

### Freeway Operation

Because control of access has such a significant effect on design, freeway speeds and capacities are usually more predictable and fewer traffic control devices are needed. Human behavior when operating free-wheeling vehicles still requires much research. A Special Freeway Study and Analysis Committee of AASHO has made extensive observations of existing freeways, toll roads and completed Interstate mileage to evaluate operating characteristics of finished highways. Major features such as alignment, profile, control of access, 12-ft. wide lanes and high-type surfaces were found to be satisfactory. Lane capacities in rural areas appeared to need reappraisal since greater speeds are attainable in rural areas than in urban areas for the same design volumes since interchanges are farther apart and design volumes are likely to be exceeded less frequently. The committee favored a 10-ft. paved right shoulder and a paved left shoulder of a nominal width. Median widths increased safety and, where only minimum widths were available, median bar-



**BEFORE:** Laying Troyturf is fast, easy (can be a one-man job). After tamping down Troyturf at one end, workmen roll out the length required. A quick cut, another quick tamping, and the job's done.

## Now...grow grass where nothing ever grew before! —use **TroyTurf**

85° inclines, slopes, flat areas — it's easy to grow rich grass in any soil with Troyturf.

Troyturf is the sturdy pre-seeded mat that contains all the ingredients you need to produce thick, thriving stands anywhere (see diagram). It comes in 90' x 54" rolls that are easy to handle, quick and easy to lay. You simply:

**Loosen soil if necessary • Roll out as much as you need  
Anchor the edges • Water**

That's all Troyturf takes. The rugged mat stays put even on steep slopes, prevents nutrients and seed from being blown or washed away, blocks erosion, inhibits weed growth. Result: thick, grassy stretches where no grass ever grew before.

Think of it — you can beautify ravines, gullies and other eyesores... lay out rich, new plots or revitalize older ones... all at a cost far lower than sodding. Can be formulated to meet the soil requirements of your area. Special sizes on request, as well.

Where do you need to grow grass? Do it the easy, money-saving way... with Troyturf. For informative brochure, write today.



Horticultural Products Division

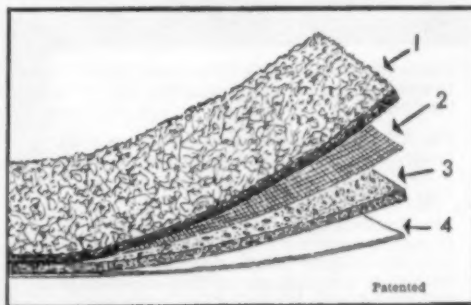
**TROY MILLS, INC.**

Founded 1865 • TROY, NEW HAMPSHIRE

Address inquiries to: 200 MADISON AVENUE, NEW YORK 16, NEW YORK

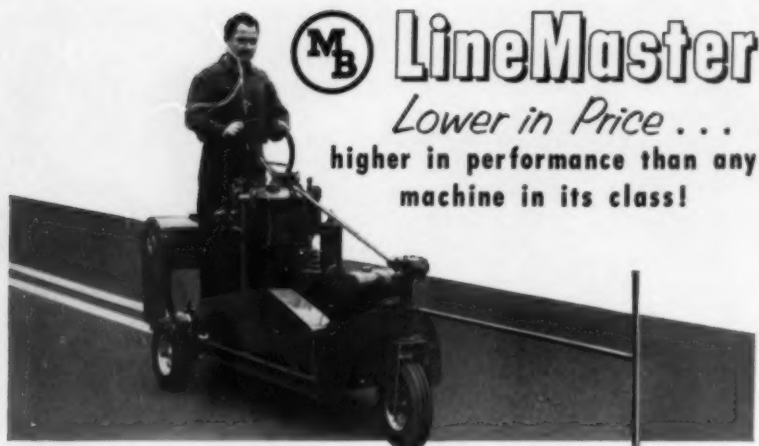


**ONE MONTH LATER,** you see the result: a vigorous stand 4 to 6 inches high that grew right through the 2 inches of sand washed down on it.



**EXPLODED-VIEW DIAGRAM** of Troyturf mat, showing: (1) sterilized jute mulch, (2) reinforcing net for erosion control and dimensional stability, (3) certified seed, peat moss and other moisture-retaining materials plus organic and mineral fertilizers and (4) seed germination paper... all "locked" together in one easy-to-handle mat.





# LineMaster

*Lower in Price...*  
higher in performance than any machine in its class!

- Rapid single or double-line marking, 1 color, 3" to 6" widths, regular or reflective, solid or intermittent.
- Self-propelled, one-man operated with striping speeds of 3 to 5 mph.
- Built-in riding platform affords operator unmatched visibility.
- Automotive-type steering and Shift-o-matic drive for effortless operation.
- Big 18 gallon paint tank and heavy-duty jet spray cups for sharp, clean stripes.

Write today for information on the complete M-B line of markers with paint capacities from 10 to 750 gallons. M-B Corp., New Holstein, Wisc., Dept. PW



M-B CORPORATION  
NEW HOLSTEIN, WIS.

LINE MARKERS • PACKER BODIES  
SWEEPERS

QUALITY MUNICIPAL AND INDUSTRIAL EQUIPMENT SINCE 1905

## THE NEW acker AMBASSADOR CORE DRILL

An Ideal Drill For:

- Heating and Ventilating
- Air Conditioning
- Plumbing
- Electrical and Building Contractors
- Telephone, Gas and Electric Utilities
- Test Laboratories
- Highway and Municipal Departments

Here's the most useful tool you can buy! It saves time, labor and money for the busy contractor.

The Acker Ambassador cores neat, clean holes in tile, concrete, reinforced masonry. And it does the job faster, quieter and cheaper than a hammer and chisel!

The Ambassador gives you 360° operation. It features a heavy duty high torque 2 speed reversible electric motor, rack and pinion feed, alloy gear unit, sturdy steel construction and rugged base. It's built to do a big job!

Ask for a demonstration or write for your free copy of Acker Bulletin 27-PW today!



## ACKER DRILL CO., INC.

P. O. BOX 830 • SCRANTON 2, PA.

riers reduced the rate of serious head-on collisions. The use of flat (4:1 or greater) slopes were preferred over guardrail on fill sections and no encroachment on the shoulder area by guardrail, lamp or sign posts or other obstruction. Ramp spacing and design were found to affect smooth flow, capacity and safety. Exits should be clearly visible and usable without deceleration on the through-traffic lanes. Entrances should be one lane wide at point of merging with a long flat-tapered merging area constructed at the same elevation as the through-traffic lanes. Entrance and exit ramp spacing on the freeway should be such that taper sections do not overlap. Inexpensive diamond-type interchanges appeared to be most appropriate in rural areas and many urban areas.

"Freeway Operation — Observations Reveal Good and Poor Highway Design." By Joseph Barnett, Deputy Assistant Commissioner for Engineering, Bureau of Public Roads, Washington, D. C. *Civil Engineering*, January, 1961.

### Roadside Maintenance

California State highway roadides are classified as those with native cover, those with functional planting and those with special landscaping. Four-foot fireguards are maintained adjacent to shoulders and two-foot fireguards adjacent to gutters by use of soil sterilants applied at a total cost of from \$70 to \$100 per acre. Noxious weed control is performed by the local counties under contract with the State. Mowing of the entire right-of-way is done on primary roads three to four times each year. Rotary mowers are replacing other types used previously. The 1959-'60 fiscal year cost of rotary mowing was \$7.09 per acre. Litter removal cost \$1,250,000 during the same period. Where sand drifting occurred in desert areas, fencing was used (like snow fence) or native vegetation planted. Landscape and roadside vegetation control in all phases accounted for 11.3 percent of the maintenance dollar during the past year. Median plantings, primarily for headlight glare elimination, cost an average of \$400 per mile to maintain last year.

"California's Practice on Maintenance of Roadsides." By F. E. Baxter, Maintenance Engineer and W. H. Armstrong, Highway Landscaping Engineer, California Division of Highways. A paper presented at the 46th Annual Meeting of the American Association of State Highway Officials, Detroit, Michigan.

## Epoxies Seal Bridge Deck

Hairline cracking over reinforcing steel and progressive spalling of the cracks were successfully corrected on the Garden State Parkway bridge decks through the mechanical application of epoxy polysulfide and emery grit. Past experiences on the New Jersey Turnpike had proven the method and material to be satisfactory but costly. The 1960 sealing of the Garden State Parkway's Mullica and Bass River Bridges was done with parkway personnel at a total cost of only \$1.05 per square yard. A mechanical mixer for the troweling compound and a two-component spray applicator for the sealant were made available by the Union Carbide Plastics Company. The 1100 gallons of polysulfide epoxy was purchased in 55 gallon drums from the Thiokol Chemical Company. Decks were cleaned by sandblasting, unsound concrete removed and spalled areas or cracks over 1/8 inch wide filled with a sand-epoxy mix before the sealing operation began. The seal coat was sprayed onto the deck surface at a thickness of 10 to 15 mils, giving a coverage of 100 sq. ft. per gal. The No. 20 emery grit (passing No. 8 screen, retained on No. 30) was broadcast at the rate of two lbs. per sq. yd. on top of the freshly-applied sealant using the sandblast equipment (with the nozzle removed). The operation progressed at about 5,000 sq. ft. per hour.

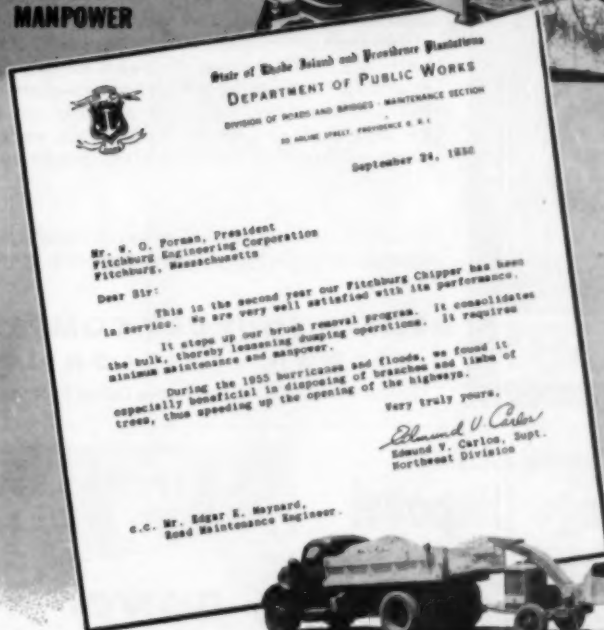
"Corrective Measures Employing Epoxies on Concrete Bridge Decks on New Jersey's Garden State Parkway." By Harold W. Goldberger, Engineer of Maintenance, New Jersey Highway Authority, Garden State Parkway, Red Bank, New Jersey. A paper presented at the 40th Annual Meeting of the Highway Research Board in Washington, D. C.

## Cleveland Innerbelt

Over 20 years ago the first cloverleaf interchange was constructed in Cleveland, Ohio as a part of its Willow Freeway. This work was a forerunner of the freeway system developed in a 1944 master plan and implemented by the 1956 Federal Highway Act. The heart of the Cleveland freeway system is the Innerbelt forming a partial loop around the downtown business district and spanning the meandering Cuyahoga River valley. The Innerbelt, just over three miles in length, will cost about \$75 million. The new Cuyahoga River bridge, already

## FITCHBURG CHIPPER STEPS UP Rhode Island Brush Removal

- ...CONSOLIDATES  
THE BULK
- ...LESSENS  
DUMPING OPERATIONS
- ...REQUIRES MINIMUM  
MAINTENANCE
- ...REDUCES  
MANPOWER



Brush disposal cost can be reduced.

Your City will find that the Fitchburg Wood Chipper is money-saving equipment in your Highway or Park Departments. Tree trimmings are quickly reduced into load-saving wood chips. Fewer loads cuts your loading and hauling expenses. Brush removal becomes a faster, simpler, less expensive operation.

Fitchburg Wood Chippers are engineered to stand hard use, to give long service without excessive maintenance costs. There is only one Wood Chipper on the market today with a One Year Guarantee...The Fitchburg Wood Chipper.

Send for a copy of "Chip Dollars From Your Overhead."



### NEW FREE BOOK "Chip Dollars From Your Overhead"

Complete with cutaway color drawings of Chipper in action. Specifications, etc.

### FITCHBURG ENGINEERING CORPORATION

Fitchburg, Massachusetts, Dept. PW-13

Send my free copy of "Chip Dollars From Your Overhead" to:

Name

(Position or Company)

Address

City  State

### FITCHBURG ENGINEERING CORPORATION

FITCHBURG, MASSACHUSETTS



**500  
TONS  
OF  
CASTINGS  
DAILY!**



With the recent opening of plant #2, shown above, our production potential of Gray and Ductile Iron Construction and Industrial Castings has now reached a maximum of 500 tons daily. This capacity, plus 15,000 patterns, plus a good on-hand supply of standard castings, plus 90 years experience in the business, is your assurance of prompt delivery, superior quality, complete uniformity and practical economy.

\* \* \*

New and fully illustrated 168-page catalog of construction castings will be sent promptly upon request.

**NEENAH FOUNDRY COMPANY**  
**NEENAH • WISCONSIN**

Chicago Office: 5445 North Neva Avenue, Chicago 31, Illinois

## Planning to build a Sewage Disposal or Filtration Plant or Lift Station...

other vital services depending on  
Uninterrupted Electrical Power?

Your plans must include assurance this service won't be inoperative when normal power fails. Katolight Power Plants take over instantly to assure you of dependable, uninterrupted use of vital electrical equipment.

Whether your requirements call for portable, standby or continuous power, you'll know you're safe when you install a Katolight Power Plant. Advanced features assure long life . . . low cost, dependable operation. Katolight, a pioneer in electric power plants, is experienced and equipped to meet standard and special applications to 750 KVA.

BE SURE OF CONTINUOUS OPERATION WITH  
**KATOLIGHT EMERGENCY  
POWER PLANTS**



WRITE  
REGARDING  
YOUR SPECIFIC  
REQUIREMENTS!

**KATOLIGHT CORPORATION**  
Mankato, Minnesota

Box 891-107

**A DEPENDABLE  
BUYING SOURCE**

**power  
sweeper  
refill  
fibres**

Wide variety of  
domestic and imported  
fibres. Large or small filled  
immediately from huge ware-  
house stock.

**gutter  
wire**

Tough and durable. In gauges  
and lengths to suit your needs.  
Write or call VAndyke 2-0987  
for prompt Steiert service.

**A. STEIERT & Son, Inc.**  
Hatfield, Penna.

completed, is the widest ever built in Ohio with four traffic lanes in each direction having a total capacity of 95,000 vehicles per day. The Innerbelt will have 37 ramps and 27 bridges along its short 300-ft. wide right of way.

"Cleveland Innerbelt - Assurance for the Future." By Louis L. Drasler, Director, Dep't. of Public Services, Cleveland, Ohio. *Highway Magazine*, January, 1961.

### Other Articles

"Electronic Control of Traffic Signals." Use of radio for synchronization and control of traffic signals is under test in New York City. *PUBLIC WORKS*, February, 1961.

"Use of Soil Cement Cuts Street Costs." Economical construction of residential streets was accomplished through use of a soil cement base and an asphaltic surface treatment. By Frank Force, Manager-Engineer, Borough of Hellertown, Pa. *PUBLIC WORKS*, February, 1961.

"Lime Used to Improve Hot Mix." Stripping, swelling and strength characteristics were improved by use of hydrated lime as an additive in asphalt mixture. By A. Leo Gallagher. *PUBLIC WORKS*, February, 1961.

"Successful Repair of Street Openings." A review of the important considerations for successful restoration of trench openings in roadway pavements. By E. F. Hensch, Director of Public Services and City Engineer, Duluth, Minn. *PUBLIC WORKS*, February, 1961.

"Expressway Design Fits Valley Restrictions." Bin-type retaining wall assisted construction in area of excessive ground water and unstable soils. By W. E. Gillespie Roadways Design Engineer, City of Edmonton, Alberta, Canada. *PUBLIC WORKS*, February, 1961.

"One-Way Pairs Pay Off on Urban Through Routes." By F. B. Crandall, Traffic Engineer and Dennis L. Peterson, Engineer Economist, Oregon Highway Department. *Street Engineering*, January, 1961.

"Advise and Convince." Engineers and industry must be prepared to support the highway programs during the decisive year of 1961. By L. W. Prentiss, Executive Vice President, American Road Builders Association, Washington, D. C. *American Road Builder*, January, 1961.

• • •

### Radioactive Waste Treatment

Dorr-Oliver Incorporated, Stamford, Connecticut, has been awarded a research and development contract by the Atomic Energy Commission to study factors relating to the disposal of low-energy radioactive waste material. The investigation will be carried out by Dorr-Oliver personnel at the Oak Ridge National Laboratory.

*PUBLIC WORKS for March, 1961*



### A "440" for city of Laurel, Miss. —

This LeTourneau-Westinghouse grader is one of the city's favorite tools for low-cost construction and maintenance of streets and roadways. "440" is shown putting unused street back into shape. Job included stripping off vegetation, smoothing surface, and cleaning ditches. Operator D. T. Ishee likes machine's operating speed, says, "It carries a good load in 3rd gear."

Why cities and  
counties choose  
LW graders

**Copiah County, Miss., likes heavy-duty POWER-Flow® model —** "Our new '550' POWER-Flow LW grader is the most durable, dependable, and flexible grader on the market," says A. B. "Bryan" Barlow, supervisor for Copiah County. "We've found it will move more dirt than any other make and it requires little maintenance. We learned that from our '660'. In the 5 years we've had it, it has required no major maintenance. LW graders are trouble-free graders!"

"Our new '550'—equipped with torque converter — lets us do our work faster. It gives us a continuous flow of power, keeps us from bogging down. The 145-hp machine takes a bigger bite and moves more dirt every pass. What's more, our operators like it. The '550' is easier to control and handle... a good machine always makes the operator work better!"

G-2312-PJ-1

We will be happy to show you a LeTourneau-Westinghouse grader in action so you can see how its many important advantages help you complete jobs faster, at lower cost. There's a size LW grader to fit your every need, 85 to 190 hp. Ask for complete details.



**LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS**

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

## STREET and PARK



Type 48-F

### Refuse Receptacles

TRACO receptacles are smooth, ruggedly built of all-welded heavy gauge steel . . . holds a big 5 bushels of trash. Locking removable hood. Baked enamel. Innerliners available.

**FEATURE:** Two self-closing doors hang vertical . . . keeps out rain and snow.

### TARRANT MFG. CO.

28 JUMEL ST.  
SARATOGA SPRINGS, N. Y.

### BUILD BETTER SEWER LINES



with  
**WESTON**  
**GASKETS and FORMS**  
for  
**SEWER PIPE JOINTS**  
(a cement joint)

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

**L. A. WESTON CO.**

Adams Mass.

## Refuse Disposal for a County

Over a period of some ten years, Hamilton County, Ohio, has been confronted with the problem of garbage and refuse disposal due to the rapid population growth in the Cincinnati area, largely in unincorporated communities. A study by Alfred Le Feber & Associates, consulting engineers of Cincinnati, has summarized the problem and presented recommendations for its solution.

In order to obtain the information required a questionnaire was sent to each of the 47 political units in the county and follow-up letters were sent in an effort to expedite replies. In many cases further information was procured by telephone and by personal calls; a total of 41 replies were finally received. Nearly all were incomplete; and when information was given as to the weight of the refuse and combustibles, the data were very inconsistent and widely differing from the national averages of 2 pounds per day per person recently reported by the American Public Works Association.

On the basis of 2 lbs. per person per day, the city of Cincinnati would require an incinerator capacity of 530 tons per day for its 530,000 population. However, the Cincinnati incinerators, which have a nominal capacity of 900 tons per day are frequently overloaded. On the basis of 900 tons of refuse per day, the production is about 3.38 pounds per capita. It was assumed that domestic refuse production was 2 lbs. per person per day and that the additional 1.38 pounds represented commercial and industrial waste.

#### Total Capacity

In studying the data from the questionnaires and supplementing this information by personal investigations of the various incinerators in use in the area, the collection practices and the landfill and dump areas, it was determined that the Cincinnati figures should be applied to the county as a whole. On this basis, the population of 370,000 outside of Cincinnati would require a disposal capacity of 625 tons per day, less existing facilities. For the probable 1970 population of 1,033,000 for the city and county, an incinerator capacity of 1,750 tons would be required; and the 1980 requirement would be 2,015 tons.

Including a 250-ton incinerator now being constructed as a private

project in the northern part of the county and six smaller municipal incinerators, there is available a rated operating capacity of 326 tons per day. Norwood has under construction a 150-ton unit; and Cincinnati's installed capacity is 900 tons. This gives a total existing capacity of 1,376 tons per day. However, allowance should be made for down-time. The actual Cincinnati capacity is about 10 percent below the rated capacity; operation on this downtime basis is at 117 percent at peak load times; and the load is growing at the rate of about 5 percent per year.

Assuming the required present capacity of 1,525 tons per day, the immediate deficiency is 149 tons per day which will increase to a probable 500 tons in 1970 and to nearly 800 tons in 1980, with no allowance for increasing age of the present incinerators. Accordingly immediate construction of a 500-ton unit is recommended.

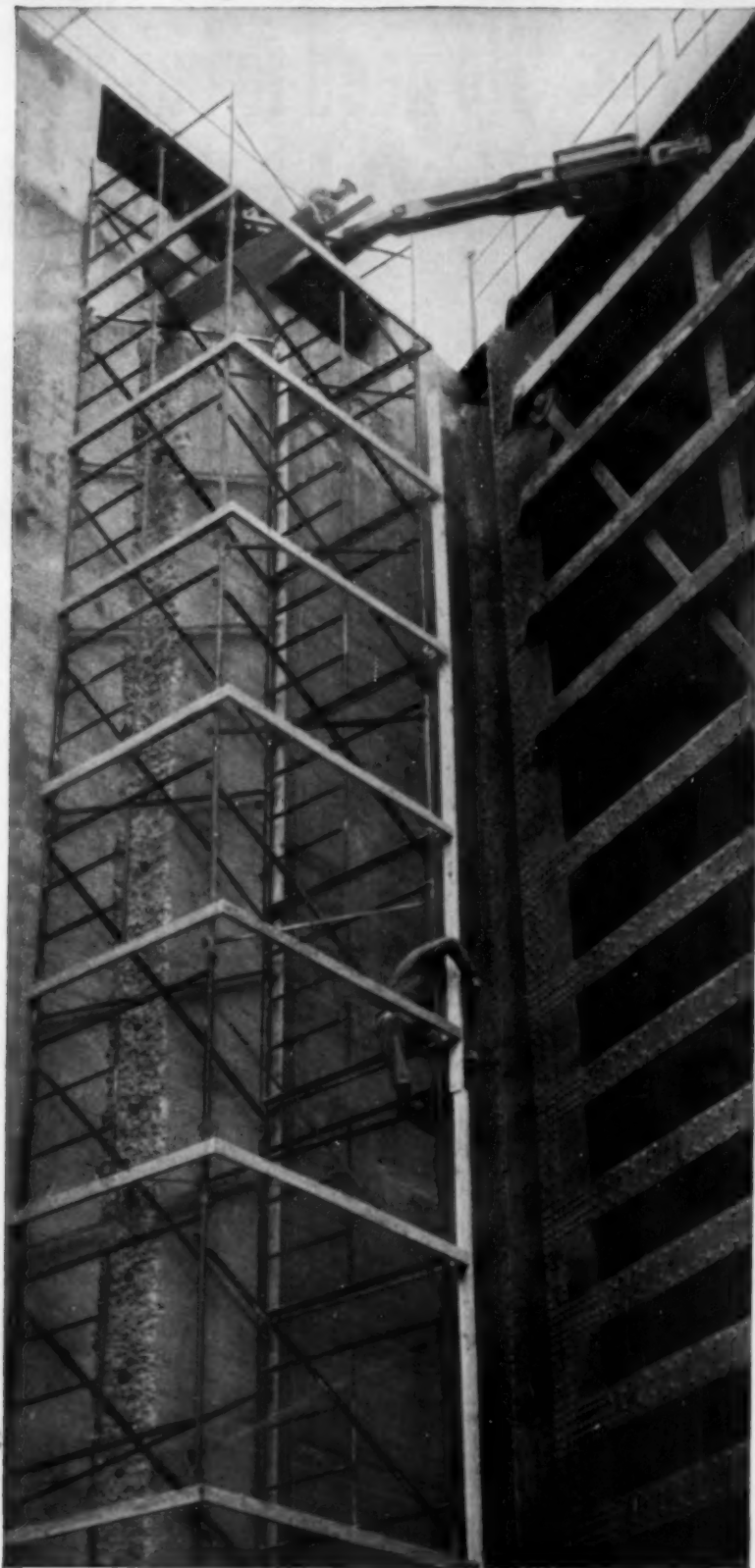
#### Financing

Though there are various methods of financing possible, it is recommended that the county construct and operate this new unit. Cost is estimated at \$2,400,000, including land, financing, engineering and construction. Annual operating costs are estimated at \$470,000 and for incineration of 130,000 tons (500 tons per day for 260 days per year) the cost would be \$3.65 per ton. However, since the initial load would probably not exceed 300 tons per day, operating expenses, while reduced overall, would increase to an estimated \$5.00 per ton for a time.

Over the ten-year period during which this problem has been under consideration, the only noticeable changes in the situation have been an increase in the urgency for a solution and the growing difficulty in finding land areas for landfills or dumps. Adjoining Clermont County has resorted to litigation to exclude dumping of Hamilton County refuse. Some private contractors serving the smaller villages have acquired land in Indiana. In general, as the population in the county increases, there will be still more serious objections to dump areas because of flies, odors, rodents and the passage of refuse vehicles.

The report on which this article is based was sent us by Harold H. Mace of Alfred Le Feber & Associates.

# HOW TO MAKE LITTLE OF BIG REPAIRS



## Polysulfide-epoxy adhesive speeds, simplifies concrete reconstruction on big river lock

After years of wear and weather, Lock #1 desperately needed reinforcing. Repair time was important. Shipping could not be interrupted for an extended period. Soil conditions were poor. Driving sheet piling proved impractical.

Through use of concrete adhesive combining THIOKOL polysulfide polymer and epoxy resin, engineers met the problems squarely.

By applying the compound to existing base structures (areas where concrete had worn and eroded), they were able to add new sections of reinforced concrete. Adhesive bond between old and fresh concrete provided by the polysulfide-base material proved stronger than concrete itself, in effect created one continuous structural unit.



Repairing sidewalls: polysulfide-epoxy adhesive used to grout steel dowels into existing walls, cured inside 24 hours. Well-anchored dowels tie old and newly-poured-in-place vertical columns of concrete. A strong, unified structure delivered well within limited time schedule.



Waterproof, practically indestructible, the bond produced by THIOKOL polysulfide polymer/epoxy adhesive has restored better-than-new serviceability to highways, bridges, buildings, dams, locks, reservoirs. Big job and small, all were done with great economies in time and dollars. For full information, write for brochure CA-200.

## **Thiokol®**

**CHEMICAL CORPORATION**  
780 N. Clinton Ave., Trenton 7, N. J.

In Canada: Naugatuck Chemicals Division,  
Dominion Rubber Company, Elmira, Ontario





# No need to baby it when it's fabricated from Beth-Cu-Loy corrugated galvanized steel sheets

You don't have to be gentle with long lengths of Beth-Cu-Loy drainage pipe when you lay them in the trench. And you don't have to worry about curing and setting time when making field joints. Your trench doesn't have to be a featherbed, nor will you have a problem with grade and alignment.

*Rugged corrugated Beth-Cu-Loy pipe can easily withstand this kind of treatment. With smaller diameters, Beth-Cu-Loy sections can often be man-handled.*

## **STEEL IS IDEAL FOR FAST WORK**

Drainage pipe made of Beth-Cu-Loy galvanized sheets has the strength, ruggedness, light weight, and flexibility of steel. Steel can take rough handling. Steel can flex to meet variations in grade and alignment. Steel can take traffic impact and vibration, and the shifting actions of soil in changing weather.



*Standard connecting bands speed up job of field-joining long lengths of Beth-Cu-Loy drainage structures.*



## **FIELD JOINTS QUICKLY MADE**

• With a Beth-Cu-Loy drainage pipe or culvert, field joints are quick and easy. You just slip a standard connecting band over the end of one pipe section, move the next section into place, then draw up the bolts on the collar of the band. Corrugations of the band nest perfectly with those of the pipe sections.

Bethlehem manufactures the Beth-Cu-Loy culvert sheets to meet the rigid specs of the AASHO. Your fabricator will be glad to give you full details on pipe made of Beth-Cu-Loy. If you wish, we will send you the name of a fabricator near you. Just drop us a line.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

*Export Sales: Bethlehem Steel Export Corporation*

# **BETHLEHEM STEEL**



*For  
Strength  
Economy  
Versatility*



# EXPERIENCE WITH PULSATING RED TRAFFIC SIGNALS

**CHARLES ALEXANDER**

Assistant Traffic Engineer,  
Montgomery, Alabama

THE CITY traffic engineering department of Montgomery, Alabama, has long been in search of improved methods of traffic control to promote safety and expedite the movement of traffic on its city streets and highways. Efforts are made to constantly improve existing traffic control equipment, to keep it up-to-date and to provide the very best facilities possible.

One phase of our re-evaluation has been to determine the effectiveness and use of traffic signals in receiving voluntary observance from drivers. Realizing that development of an adequate system of traffic control measures requires exact knowledge of the problems to be overcome, it was decided to set up a program of fact-gathering to determine those problems. The first move was one of identifying intersections throughout the city which had experienced high accident rates or considerable congestion. Accident records were closely examined and those pertaining to our problems were used. After determining the intersections to be studied, field workers were assigned to observe and record drivers' actions. Field sheets were prepared to enable the observer to record the number of vehicles that entered the intersection on green, amber after green, red, and vehicles which "jump" the red light. No attempt was made to classify the vehicles.

Generally the length of study at each station was three hours—one hour during the morning peak, one during the afternoon peak, and one during the off-peak hours. If the accident records showed an unusually heavy trend during a particular time of day, it was included in the study.

Upon completion of the studies, the data collected for all intersections was tabulated both collectively and separately. It was found that 95½ percent of all cars entered on green; 3½ percent entered on amber; less than 1 percent entered on red; and .01 percent jumped the red. While this did not indicate a marked non-observance, it was believed that observance could be improved.



● TRAFFIC signal controller has pulsating unit in lower cabinet. Relay assembly varies intensity of red indication.

After the conventional methods of improvement were exhausted, it was decided that the problem should be approached from an entirely new point of view. It was suggested that the use of pulsating lights in the traffic signals (such as those being used for outdoor advertising) might have merit. The questions to be answered were: How to incorporate flashing lights into a standard traffic signal to improve effectiveness, and what would be their value in improving voluntary observance. Obviously we had to develop a type of pulsating light which would not appear from a distance to be one used primarily to denote right-of-way. To accomplish this, a relay assembly was developed which would vary

the intensity of the red indication by varying the resistance in the line voltage. By trial and error, a rate of pulsation was decided upon which was believed to give the desired result.

Although the pulsator looked good, our experience proved that the merits of an idea are in results achieved. To prove or disprove that the pulsators had merit, we installed them at each intersection at which a driver observance study had been made. Upon completion of the installations and the elapse of several weeks to allow the drivers to become accustomed to the change, the "after" studies were made. These studies showed that 96 percent entered on green; 3 percent entered on amber; less than 1 percent entered on red, and 0.1 percent jumped the red. The studies thus indicated that the voluntary observance to traffic signals had not made a significant change. While it is possible that the pulsator did have some beneficial effect in alerting drivers at a greater distance than had been previously achieved, after careful consideration pulsators were abandoned in Montgomery.

Even though the pulsating red had failed to show a significant change in driver observance, we believe our efforts were not in vain. In proving that the pulsator was not the answer, we can turn our attention to other efforts to solve the problem.

The traffic engineer is often accused of possessing a magic wand which will cure all traffic ills by a simple movement of the hand. In



● THIS IS a typical signalized intersection with signals over each lane of traffic. Pulsating signals did not effect a significant improvement in driver observance.





# TORSION SUSPENSION

***Improves tractor performance... extends tractor life***

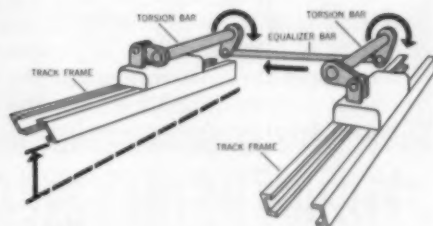
## One more reason you're money ahead with CASE Crawlers

If you've operated a crawler loader (other than a Case Model 750, 800 or 1000) you know how you get "all shook up" because there's no "give" in the tracks. Dozers and drawbar tractors with springs like a "Model T" aren't much better! Stands to reason that those jolting, spine-cracking shocks you feel are transmitted to the engine, transmission and other components — *increasing wear and decreasing service life.*

You'll find a big difference in the Case 750, 800 and 1000 Crawlers with Torsion Suspension. This unique system literally "irons out" the bumps by permitting both tracks to oscillate freely. It also gives you these additional benefits not found on any other tractor:

- *Increases traction* by maintaining maximum ground contact through exclusive cross-linkage.
- *Maintains more effective steering control.* Equalization of track loads prevents "yawing" and slipping.
- *Makes it easier to maintain smooth, level cuts* with blade or bucket, because tractor remains level on uneven footing.
- *Provides higher ground clearance.*
- *Prolongs machine life, eliminates downtime* by absorbing shock loads, eliminating twisting strains.

But why not ask your Case Industrial Dealer for a free job-demonstration and find out for yourself? Or for more information, write J. I. Case Co., Dept. C1341 Racine, Wis.



## How Torsion Suspension Works

When one track encounters an obstacle, shock is absorbed by twisting action of solid steel torsion bar. In addition, as front of track raises, the torsion bar rotates. This rotating action is transmitted by equalizer bar to opposite torsion bar, causing it to also rotate. This forces front of track on that side downward, equalizing load distribution and increasing traction.

CT-P-575

# CASE®

J. I. CASE CO., RACINE, WIS.

# HIGHWAY WEED PROBLEMS LIKE THESE



## CAN BE ELIMINATED



## LIKE THIS WITH AMIZOL WEED KILLER

*and Amizol combinations*

Using Amizol alone, or in combination with other weed killers, state and local highway departments are instituting successful and complete vegetation control programs along thousands of miles of roadsides, guard rails, gravel shoulders, bridge abutments, center strips and embankments.

Amizol combinations provide longer control of more broadleaf weeds and grasses than any product used alone. They produce rapid knockdown of existing vegetation, better kill of deep rooted perennials and keep the treated area free of weeds all season long.

Costs for total vegetation control are considerably less with Amizol combinations . . . by 30 percent or more. You use less chemical to kill more weeds. Your "spraying season" is longer, just as long as weeds are green and actively growing.

*For information on how to begin a practical highway weed control program, write for free booklet describing uses, application data and chemical formulations of Amizol—produced by Amchem Products, Inc., originators of 2,4-D and other basic weed killers.*



# AMIZOL

Amchem and Amizol are registered trademarks of  
**AMCHEM PRODUCTS, INC.** (Formerly American Chemical Paint Co.)  
AMBLER, PA. • St. Joseph, Mo. • Niles, Calif.

Montgomery, attempts are made to remove the so-called magic by arriving at solutions to our traffic problems based on engineering data and scientific research. The answer to the problem of non-observance has not been solved, only a theory disproved. However, efforts shall continue to find the answer.

The City of Montgomery has been cited by the National Safety Council for its fine safety record and achievements in the field of traffic engineering for the past several years. We are justly proud of Montgomery's fine record and although there are many factors that contribute to such a record, we believe that the re-evaluation of traffic control devices and the continuous search for new methods has helped to maintain this high standard.

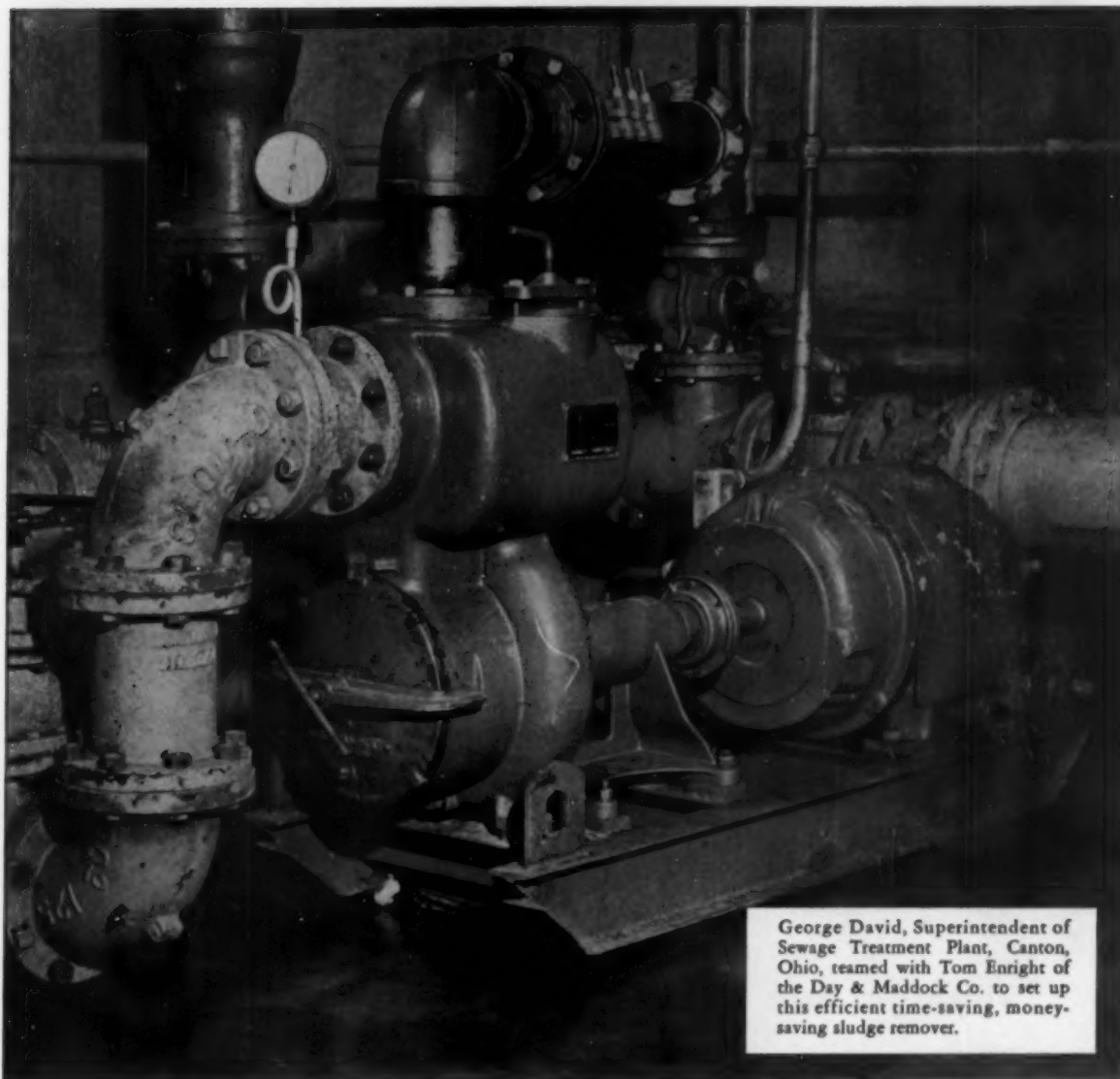
• • •

### Closed Circuit TV For Highway Control

Use of closed circuit television for traffic surveillance was demonstrated at the National Auto Show. General Electric is building an experimental closed circuit system for the highway department to implement remote electronic control of a 3.2-mile segment of John C. Lodge Freeway. By continuously monitoring the entire stretch, the system will furnish new knowledge of freeway design techniques and motorist behavior. Information gained from the experiment will be applied in highway construction over the nation.

Although the system is not slated for delivery for some time, one camera has been set up along the freeway at a point where average daily volume is 162,085 vehicles. G-E will eventually use 14 transistorized closed circuit cameras in the installation. Each will cover an area of 900 to 1,750 feet and will provide continuous surveillance of Lodge Freeway, furnishing visual information to aid in effective regulation of entrances, exits, lanes and speeds. With this control, traffic tie-ups can be prevented; accidents can be reduced; and the freeway's vehicular carrying capacity can be increased considerably.

The entire operation of the cameras, including lens control and panning and tilting, will be handled remotely from the central location which will house the 14 monitors as well as all traffic controls. Cameras will be equipped with a selection of lenses so that the operators can take close-up looks at specific traffic situations.



George David, Superintendent of Sewage Treatment Plant, Canton, Ohio, teamed with Tom Enright of the Day & Maddock Co. to set up this efficient time-saving, money-saving sludge remover.

## RECIRCULATION AND CLEANING PUMP SOLVES CANTON DIGESTER PROBLEM

Gorman-Rupp Sewage Pump cleans with no downtime and major savings

**Problem**—To remove 7-years' accumulation of sludge from 10 huge digesters. With mechanical shoveling devices, it cost \$5000 to clean only one digester. And during cleaning, digester was totally inoperative for 6 weeks.

**Answer**—A Gorman-Rupp Model 16A2-B Pump. Its unique action first agitates sludge into a common mixture by circulating digester liquid under pressure.

Then, with valves reversed, pump draws off liquid and suspended solids for disposal.

**Result**—Each digester could be cleaned in only 21 days. Only outlay is cost of 6" pump, electric motor, and labor of opening and closing 2 valves twice a day.

4" and 6" pumps can be connected to your power or ordered complete with power units. Write for complete specifications.



**Fast-Action End Plate.** Releases for access to impeller and renewable wear plate. Impeller is 2-vane trash type that handles spherical solids up to 2½" in diameter.

### THE GORMAN-RUPP COMPANY

305 Bowman Street • Mansfield, Ohio  
GORMAN-RUPP OF CANADA, LTD.  
St. Thomas, Ontario



## 400,000 MILES ON DIESEL TRUCK TRACTOR

ONE OF the basic vehicles used by the Massachusetts Department of Public Works is a giant diesel tractor, used to haul snow plows, graders, and other types of heavy equipment to snow-bound and/or disaster areas and to various service centers. Since it was purchased ten years ago, the tractor has rolled up more than 400,000 miles, much of it in the worst kind of weather.

Under these conditions, maintenance men get a chance to evaluate vehicles and accessories in terms of long-term field performance conditions. Mechanics at the Wellesley garage, main maintenance point for the entire state, recently scheduled the diesel tractor for electrical system overhaul. They found that after 10 years and 400,000 miles of hard



● **ALL-PURPOSE** rig used for snow removal and disaster control programs has piled up record mileage. The truck's electric power supply is a Leece-Neville alternator.

use, the tractor's alternator system needed only new bearings, brushes and slip rings to bring it back to peak condition.

Repetitive electrical load on the tractor includes road and flood lights; two-way radio; heavy-duty heater fans; marker and clearance

lights; and a roof beacon. The Leece-Neville alternator has supplied power for all these necessities without major attention.

Of about 350 snow removal units maintained at the Wellesley garage, 40 percent are equipped with Leece-Neville alternators.

*Speed your  
city's growth*

with an adequate,

permanent **APCO** Cast Iron Water System

Finest asset that your growing town can have is a dependable, permanent waterworks system.

When you extend your community's water mains, make quality your watchword and save taxpayers' money. Specify

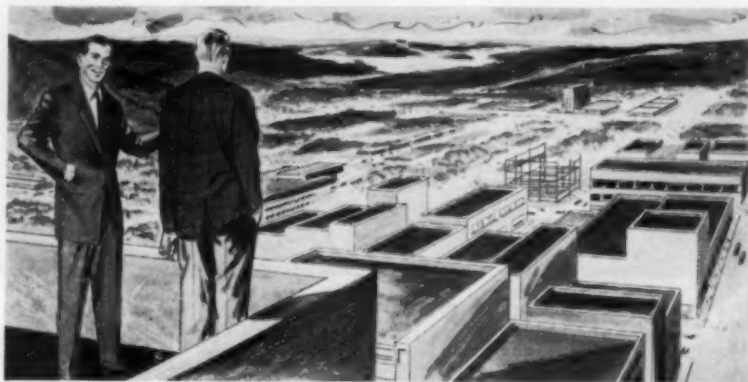
**APCO Super DeLavaud CAST IRON PIPE**

It's better by far than the Cast Iron Pipe that has served for 100 years and more in 112 cities in the U.S.A. And cheaper by far in long run costs than any substitute pipe you can buy.

APCO Pipe is available in sizes 3" to 24" in modern long lengths. **ALTITE®**, bell and spigot, and mechanical joint.

*Investigate the **APCO ALTITE® JOINT**  
for the best connection you'll ever make!*

ALTITE JOINT® Protected by Patent Underwriters Approved



Write for your copy of Catalog No. 54

**ALABAMA PIPE COMPANY**

A Division of Woodward Iron Company  
ANNISTON, ALABAMA Phone ADams 6-7601

*Sales Offices*

CHICAGO: 122 S. Michigan Avenue  
NEW YORK: 350 Fifth Avenue  
KANSAS CITY: Suite 950, 1006 Grand Ave.  
DETROIT: 18505 W. Eight Mile Road  
SOUTH GATE, Calif: 5335 Southern Ave.



## THE NEW LOOK IN INSTRUMENTS

### SPARLING FLOW INDICATOR-TOTALIZER-RECORDERS

**NEW**—inside and out—Sparling flow recording instruments reflect the ultimate in modern engineering and design. Improved construction features assure unfailing accuracy and performance in providing instantaneous and permanent flow information. Smart new styling enhances the appearance of every installation. The "new look" includes a complete line of Indicating-Totalizing-Recording instruments to meet the requirements of any

metering system with individual, remote or centralized instrumentation. *Ask your local Sparling field engineer about Sparling instruments.* Let him describe their functions; the wide range of application they offer; and how they can help increase your operating efficiency. Your Sparling representative is a metering specialist, and is available to you for assistance at any time. *Write for Sparling Equipment Bulletin 315.*

 **SPARLING**  
WATER CONTROL EQUIPMENT

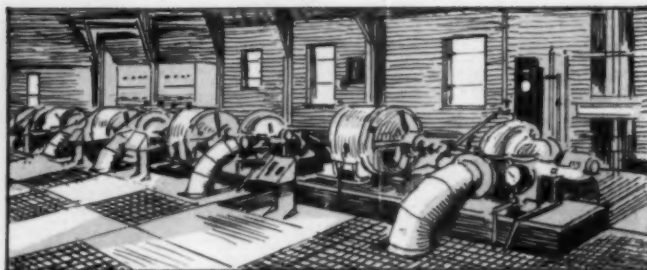
**HERSEY-SPARLING**  
METER COMPANY  
Sparling Equipment: **EL MONTE, CALIF.**  
225 North Temple City Blvd.

Branches: Atlanta • Chicago • Cleveland • Dallas • Denver • Kansas City, Mo. • Roselle, N. J. • San Francisco • Seattle • United Kingdom Affiliate: TYLORS OF LONDON LTD.

PUBLIC WORKS for March, 1961

151

# THE WATER WORKS DIGEST



Prepared by **ALVIN R. JACOBSON, Ph. D.**

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

## Automatic Alum Feed

The Hanford atomic energy plant of the General Electric Company, operated as a prime contractor for the U. S. Atomic Energy Commission, uses filtered water to cool fuel elements in nuclear reactors. Ever-increasing amounts of exceptionally clear water are required due to increased plutonium production. Automatic control of alum feed in the water treatment plant can produce water of any desired clarity. The heart of the control system is a 2-inch pilot filter tube which contains filter media similar to the media in the filtration plant being controlled. Alum-treated raw water from a model filter plant influent flume is filtered through one of the pilot filter tubes. An organic polyelectrolyte is added ahead of filtration to strengthen the floc particles. The pilot tube effluent flows through a cell on a light-scattering microphotometer. The turbidity in the flowing water scatters light thereby producing a signal which in turn actuates a controller adjusting the stroke of an alum feed pump. On the large production plants at Hanford this device is not used because the actual settling time across the basins is only a very few minutes—due to short circuits—in some of the water treatment plants. These plants generally require 1 to 2 additional ppm of alum feed more than a plant having adequate settling time to produce an effluent of similar quality. Some of the plants are being operated up to 7 gallons per square foot—rates much greater than the original design capacity representing a capital cost saving of over \$10 million.

"Pilot Unit Paces Automatic Alum Feed in Filter Plant." By W. R. Conley, Engineer, Reactor Studies, and R. W. Pitman, Engineer,

Water Plant, Research and Engineering Section, Irradiation Processing Department, Hanford Atomic Products Operation, General Electric Company, Hanford, Wash. *Water Works Engineering*, January, 1961.

## Water System Rejuvenation

Another milestone was reached in Philadelphia's 10-year master plan for modernization of its water system with the completion of the new filter building of the Queen Lane Water Treatment Plant. Other highlights have been the completion of the new \$25 million Torresdale water treatment plant in 1959 and the load control center in 1960—a microwave communications network for monitoring the distribution system. By 1963, the City's third filter plant, Belmont, will have been remodeled to complete the \$123 million modernization program bring-

ing the output capacity to an average of 486 mgd, with a potential maximum of 678 mgd. In addition, a universal metering project has been in effect since 1952 resulting in a reduction in unmetered accounts from 217,507 to 9,558 in 1959. The rehabilitation phase at the water treatment plants has been the substitution of conventional rapid sand filters for the slow sand filters. Other improvements have included the provision of coagulation and flocculation facilities, modern chemical handling and feeding equipment and advanced instrumentation at all plants.

"Rejuvenation of a Major Water System." By Clayton H. Billings, Associate Editor. *PUBLIC WORKS*, February, 1961.

## Montreal's Water System

In September, 1960, the City of Montreal dedicated its new 50-mgd

## Sea Water Conversion Plant Under Construction



Courtesy Chicago Bridge and Iron Company

● **SEA WATER** conversion plant being built at Freeport, Texas, to be operated experimentally by the Office of Saline Water, Department of the Interior. Designed for a capacity of 1 mgd, the plant will use the long-tube vertical multiple effect distillation process. The clarifier-thickener is for recycling magnesium chloride.

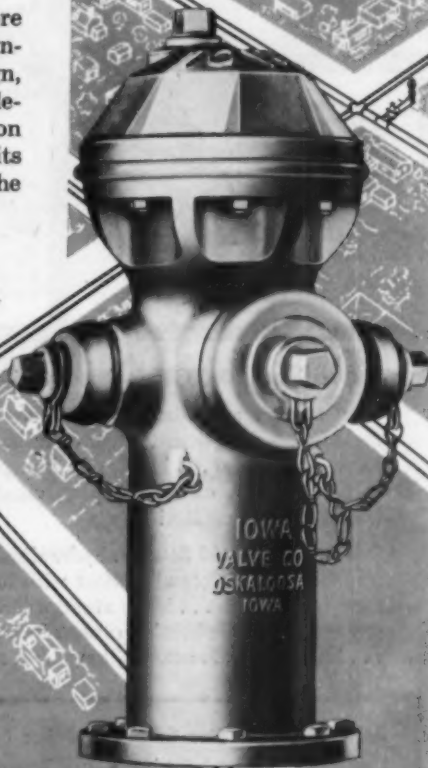


# Modernize Your Water System with IOWA VALVES and HYDRANTS

New industrial plants, new housing developments, population growth...all put increasing demands on today's water systems. They increase the need for effective control of water distribution...emphasize the importance of reliable, efficient and positive fire protection.

More than ever, it is important to be guided by recommendations of professional engineers, insurance underwriters and experienced waterworks operators; to have the proper spacing of shut-off valves—one at each intersection or at least every 500 feet; have a fire hydrant at every intersection—two at every intersection in business and industrial areas; have a planned maintenance program with regular inspection; weed out costly "orphans" from the system.

Experienced waterworks men are more and more choosing IOWA valves and hydrants for such modernization programs. These are products of proved design, require minimum maintenance and assure long-life, dependable performance. IOWA's long-standing reputation means continued availability of repair parts...permits choice of valves, accessories and specialties from the widest possible range.



Call in an IOWA man when your plans are taking shape.  
His help can save you time and money.

## IOWA VALVE COMPANY

Oskaloosa, Iowa

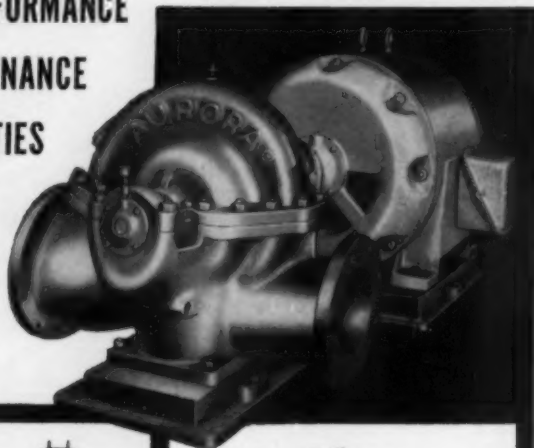
Subsidiary of James B. Clow & Sons, Inc.

# AURORA® Split Case

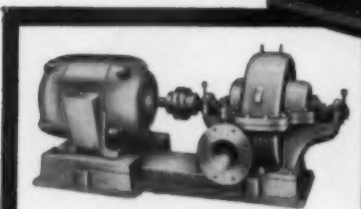
## CENTRIFUGAL PUMPS

with

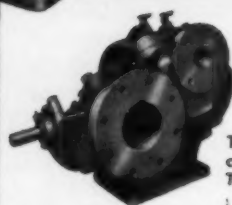
- SMOOTH PERFORMANCE
- EASY MAINTENANCE
- HIGH CAPACITIES



Type OJ Horizontally Split Single Stage Double Suction. Bulletin 105-B.



Type AJ Horizontally Split Two Stage Opposed Suction. Bulletin 106-B.



Type AJ Diagonally Split Two Stage

Bulletin 106-DS

- Capacities to 6000 GPM—heads to 600 feet—continuous operation.
- Both suction and discharge on bottom half of case... piping or motor-pump alignment never disturbed... lugs on top half of case for easy removal... by-pass in lantern ring exposed in lower half of case... fast, easy to inspect, clean and maintain... lines are back in operation fast!
- Streamlined liquid flow... hydraulically and dynamically balanced impellers... perfect alignment with in-line boring with top half of case in position... large standardized shaft sizes for maximum strength... short bearing centers for maximum rigidity and balance... low NPSH... smooth, long-term top performance... long life!

**IDEAL FOR:** Water Service • Boiler Feed • Circulating • Cooling Tower • Pressure Build-Up • Fuel Transfer • Boosting to Pressure or Elevated Tanks • Many General Applications.



FOR COMPLETE INFORMATION WRITE—OR CALL  
**AURORA PUMP** DIVISION  
 THE NEW YORK AIR BRAKE COMPANY

630 LOUCKS • AURORA, ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK



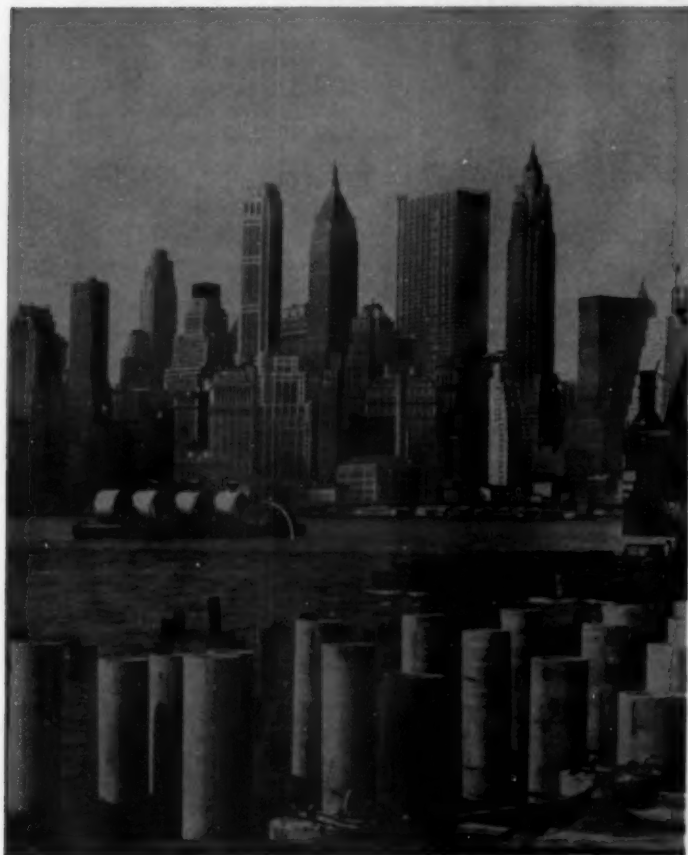
rapid sand filter Gallery raising the plant's capacity to 300 million gallons per day completing the expansion potential of the present plant site. The present raw water supply is taken from the St. Lawrence River and is of such quality that only rapid sand filtration, followed by chlorination, is required for treatment. The absence of preconditioning has one drawback in that algae during the cold winter season must be strained out of the water before reaching the filters. One solution to the problem has been the installation of a Microstrainer which is now operating as a pilot plant supplying up to 8 mg of strained water per day. The use of additional Microstraining units is predicted on the successful operation of the pilot plant. The new filter gallery consists of two batteries of eight filters each. The filters are 12 x 50 feet in size, consisting of 15 inches of gravel supported on 30 inches of sand having an effective size of 0.55 mm to 0.60 mm. The underdrain system consists of cast iron manifolds and laterals with 3/16-inch ID orifices.

"Montreal Adds 50-Mgd Gallery to Raise Filter Capacity to 300 Mgd." *Water Works Engineering*, January, 1961.

### Universal Metering

The City of Warren, Mich., a metropolitan suburb of Detroit, has combined 100 percent metering of all service and standardization on meters to meet the double squeeze on water facilities caused by rapid population growth and a sudden rise in industrial activity. Since 1941, the city standardized on meters and at present has more than 21,300 Neptune Trident meters in service ranging in size from 3/4 x 3/4-inch to 16 inches. This has resulted in low maintenance cost, sustained accuracy, and interchangeability of parts. Universal metering has been indispensable for several reasons. First, all water is purchased from the City of Detroit and must be paid for on the volume basis. Another reason is the heavy industrialization of the city. Finally, there is a constant strain on treatment and distribution facilities because of the rapid population growth and industrialization. The city now accounts for over 92 per cent of all water pumped, the only services being estimated are fire hydrants and the city is charged \$10 per hydrant per year for this service. All inspection, maintenance and repair functions are efficiently handled in a well-equipped meter shop staffed by two

## METROPOLIS OR MOUNTAIN TOP



## PILE SLEEVE OR PIPELINE

LOCK JOINT PIPE COMPANY products for a variety of purposes are offered on a world-wide market. The majestic New York skyline looks down on a bargeload of 144" Lock Joint Concrete Subaqueous Pipe en route to a metropolitan sewer outfall project, as well as on Lock Joint Concrete Pile Sleeves being installed for the Port Authority's pier construction program.

15,000 feet up on the bleak slopes of the Andes, the installation of 40 miles of Lock Joint Concrete Pressure Pipe made vital water available to the Southern Peru Copper Company's \$300,000,000 mining enterprise.

So it is throughout the world. Lock Joint products are bringing fertility to the Negev Desert. Additional water flows to thriving Cape Town through a Lock Joint supply line. Lock Joint transmission and distribution mains as well as sewer lines help meet greatly increased demands in booming Caracas. These are only a few of the thousands of communities at home and abroad served with complete satisfaction by Lock Joint Pipe Company.



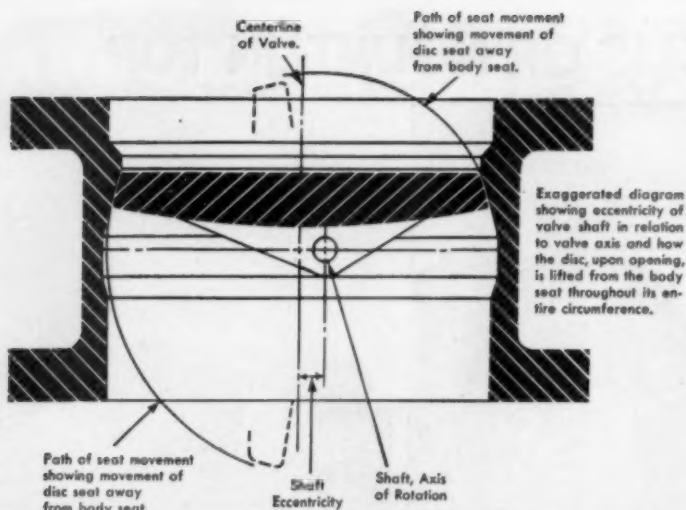
### LOCK JOINT PIPE CO.

East Orange, New Jersey

Member of the AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Kan. • Perryman, Md. • St. Paul, Minn. • Winter Park, Fla.  
Pressure • Water • Sewer • **REINFORCED CONCRETE PIPE** • Culvert • Subaqueous





## HOW DARLING-PELTON BUTTERFLY VALVES lick common problems!



**Problem No. 1—COMPLETE SHUTOFF.** With a continuous, 360 degree, rubber sealing ring, uninterrupted by the valve shaft, *drop-tight* shutoff becomes possible!

**Problem No. 2—SEAT LIFE.** With the valve disc swinging on an axis eccentric to the valve centerline, the disc lifts away from the body seat upon opening—abrasion and distortion are avoided. Moreover seat life

is further prolonged by easy, compensative adjustment.

**Problem No. 3—MAINTENANCE.** Maintenance is minimized and simplified due to the unique seat ring principle. No sealing problem around the shaft. The rubber seat is replaceable in or out of the line without dismantling the valve!

Get *all* the facts on performance and sizes. Made to A.W.W.A. Specifications. Send for Bulletin 5904.



**DARLING VALVE & MANUFACTURING CO.**

Williamsport 22, Pa.

Manufactured in Canada by

The Canada Valve & Hydrant Co., Ltd., Brantford, Ont.

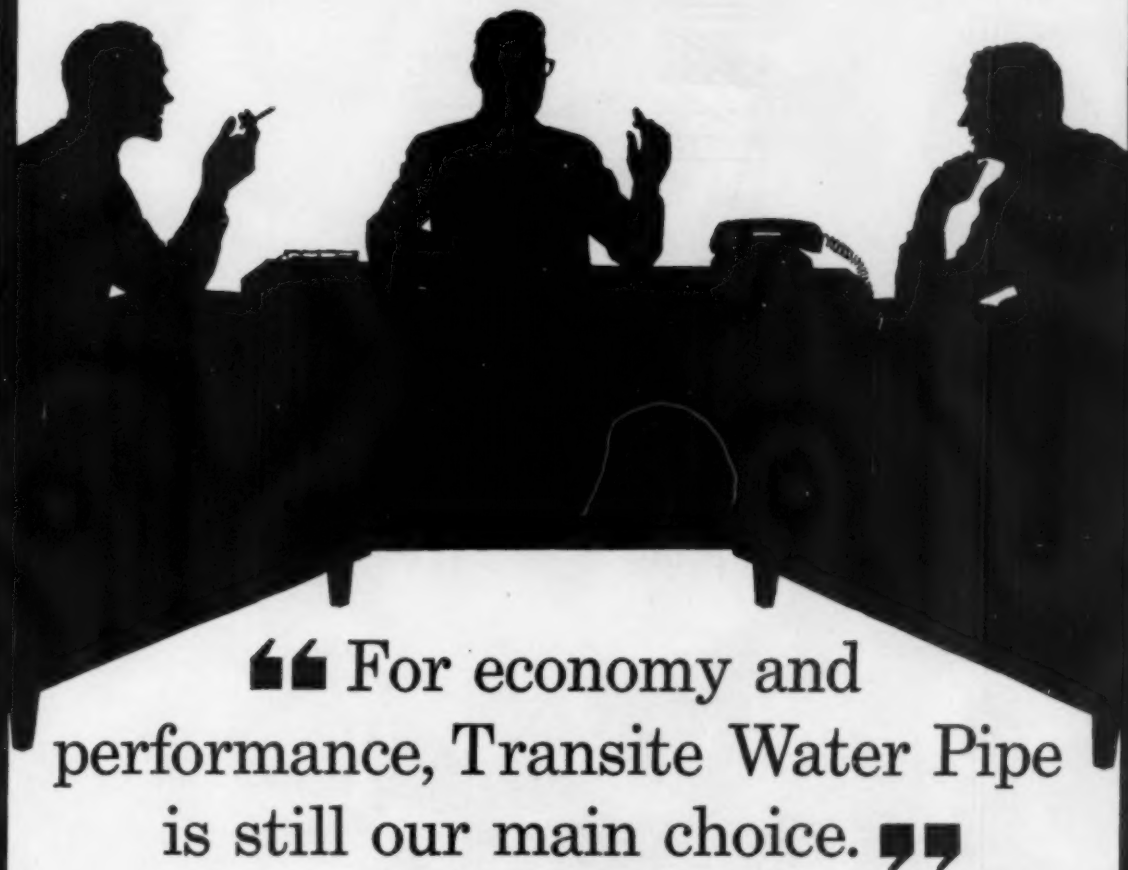
meter repairmen, each meter being tested and inspected before installation and again after registering 125,000 cu. ft.

"Warren, Mich., Adopts Universal Metering and Meter Standardization." By C. P. McGrath, City Engineer & Director of Public Service, City of Warren, Mich. *Water Works Engineering*, January, 1961.

### Effect of Fish Poisons on Water

Pure rotenone or toxaphene, currently the principal toxic agents used in fish poisons, are practically never used alone for fish management operations. For ease of handling and to enable effective dispersion, these toxic materials are invariably formulated with other materials that include synergists, solvents, emulsifiers or clay carriers. In this article the authors report the results of experiments aimed at assessing the odor potential of various fish poison formulations and the ability of water treatment processes to remove these odors. These studies show that the resulting odor may be removed effectively by activated carbon. No other common water treatment process will successfully reduce the odor of 2.0 mg/L of fish poison formulation to acceptable levels. The doses of carbon required for the formulations tested in the study were 36-85 mg/L, an unusually large dosage, which would be a serious economic burden in the routine treatment of water. However, these large dosages would be necessary only very infrequently as fish poison formulations would be applied for only a short period of time and at infrequent intervals. Use of formulations containing toxaphene would require sustained treatment with carbon because of the high stability of the toxaphene. It is recommended that a more suitable solvent be developed for use in formulations intended for water supply application. In addition to the usual requirements for a solvent demanded by the manufacturer or user, solvents should: 1) Have a high threshold odor concentration (the solvent should produce little or no odor when suspended or dissolved in water in a concentration of 2.0 mg/L); 2) be non-toxic to humans and other mammals; 3) be of known composition; and 4) be readily dissipated by natural and biologic agencies after dispersion in a water. These characteristics are met by such solvents as acetone or isopropyl alcohol and undoubtedly other solvents.

Three County Commissioners from Ohio report:



“For economy and performance, Transite Water Pipe is still our main choice.”

*Belmont County, Ohio, Commissioners William H. Dorsey, Austin C. Furbee and Louis T. Salvador.*

“Belmont was one of the many counties that experienced a building and population boom. Fortunately, our officials had the foresight to recognize its ultimate effect on our water system and service. As early as 1953, plans were made to meet future demands. Surveys were made . . . operating men and engineers were consulted . . . pipe materials investigated.

“In 1956, we extended our water system 13 miles. The installation and operating economies are now a matter of record. The successful performance of the extension is attributed to careful planning, helpful advice and, in part, to the selection of Transite Pipe.

“When we began designing another expansion of the system for 1960, our previous experience made Transite the main choice. The Belmont Water System now has 53 miles of Transite installed in rocky terrain and corrosive soils. The excellent performance of the first 13-mile section leads us to believe that Transite will provide economical maintenance and operation for many years.”

For the full Transite® story, write Johns-Manville, Box 14, PW-3, New York 16, N. Y. In Canada: Port Credit, Ontario. Cable address: Johnmanvil.



**JOHNS-MANVILLE**  
TRANSITE PIPE

THE WHITE PIPE THAT PROTECTS PRICELESS WATER

# Horizons of Modern America



1,500,000 gallons—Wheaton, Ill.



750,000 gallons—Rochester, Mich.



500,000 gallons—Lewiston, Tex.





...include

Horton Spheroidals

for

BONUS

CAPACITY



The 2,000,000 gallon Horton Spheroidal elevated tank in Ft. Worth, Texas, is a graceful symbol of contemporary, efficient water storage.

An original CB&I design introduced in 1958, the spheroidal tank requires less steel than conventional designs. The economies are readily apparent, often resulting in bonus

capacity at very little additional cost over other designs. Capacities range from 200,000 to 3,000,000 gallons.

This is another example of how CB&I's ingenuity in design, craftsmanship in steel, and complete responsibility from start to finish can be beneficially applied to your water storage tank. For additional infor-

mation, contact Chicago Bridge & Iron Company, 332 South Michigan Ave., Chicago 4. Ask for Brochure A-30, "Elevated Steel Storage Tanks."

CB&I

"Effect of Fish Poisons on Water Supplies." Part 2. Odor Problems. By Jesse M. Cohen, George A. Rourke, and Richard L. Woodward, all of the Water Supply & Water Pollution Research Branch, Robert A. Taft San. Eng. Center, Cincinnati, O. *Journal AWWA.*, January, 1961.

#### Meter Maintenance Practices

The maintenance, periodic testing, and repair of water meters have received considerable attention over the years, but there is a consider-

able lack of consistency in maintenance practices within the industry as shown by responses to a questionnaire circulated by the East Bay Municipal Utility District, Oakland, Calif., to 83 public and private agencies retailing water directly to the consumer. Responses were received from 52 utilities representing more than 4,000,000 meters. Information was requested on the following categories of meter practices: 1) Cleaning; 2) repair; 3) testing; 4) purchase; and 5) replacement. From the responses to the survey the most obvious conclusion is that meter

overhaul and testing practices is still an art rather than a science. Prior practice and opinion appear to play a strong part in determining what procedures are used. It is also indicated that water quality has little or no correlation to the meter cleaning and overhaul practices, nor is there any correlation between water quality and programs for the replacement of meters. In this study the author concludes that significant economies may be realized in the purchase, testing, and rebuilding of  $\frac{3}{4}$ -in. domestic-service water meters by adopting the following practices where they apply: 1) On meter purchase require compliance with AWWA C705 and C700; 2) require vendors to supply original or photostatic copies of their test records on meters furnished; 3) sample-inspect new meters on the basis of a statistically valid acceptance plan; 4) reduce used-meter cleaning to the simplest practical terms; and 5) require repaired meters to meet the recommended accuracy requirements of AWWA C705.

"Survey of Meter Purchase, Test, and Repair Practices." By Robert C. Sisco, Production Control Supervisor, East Bay Municipal Utility Dist., Oakland, Calif. *Journal AWWA.*, January, 1961.

#### Other Articles

"Texas Prepares to Evaluate Radioactive Water Pollution." Background conditions of streams is determined in anticipation of future increases in radioactive pollution. By Herbert A. Bevis, Chief, Ionizing Radiation Program, Division of Occupational Health, Texas State Department of Health, Austin, Texas. *Public Works*, February, 1961.

"Occurrence of Beggiatoa Species Relative to Pollution." Research indicates that the Beggiatoa are not responsive to environmental pollution changes. By James B. Lackey, Prof. of Sanitary Science, University of Florida, Gainesville, Florida. *Water & Sewage Works*, January, 1961.

"The Outlook for Water Company Financing." The author discusses reasons for the difficulties that persist in water company financing. By F. J. McDiarmid, Vice President, Lincoln National Life Insurance Co., Fort Wayne, Indiana. *Water & Sewage Works*, January, 1961.

"Methods for Determining Radon-222 and Radium-226." By Frederick B. Higgins, Jr., Graduate Research Asst.; Werner N. Grune, Prof. of Civ. Eng.; and Benjamin M. Smith, Graduate Research Asst., all of San. Eng. Research Laboratories, Georgia Institute of Technology, Atlanta, Ga., and James G. Terrill, Jr., Asst. Chief, Div. of Radiological Health, USPHS, Washington, D. C. *Journal AWWA.*, January, 1961.

## PALM SPRINGS chose a STEEL TANK



... the only type of water storage tank built to AWWA standards!

Palm Springs, the California desert playground of movie stars and sun-worshippers, is a thirsty city. There are more gardens and swimming pools per capita than any other place in the world. Fortunately, the San Jacinto Mountains have an abundance of underground streams. A new 5,000,000 gallon steel reservoir, erected on the side of rugged Mt. San Jacinto provides the necessary storage and pressure for the vital water supply.

**STRENGTH**  
**TIGHTNESS**  
**ELASTICITY**  
**ECONOMY**  
**LONG LIFE**

... these are inherent qualities of welded steel construction. Compare steel tanks with other types... you'll see why "steel tanks store water best." You can always specify steel tanks with confidence.

**More Than 10 out of 11 Water Storage Tanks Are Constructed of STEEL**

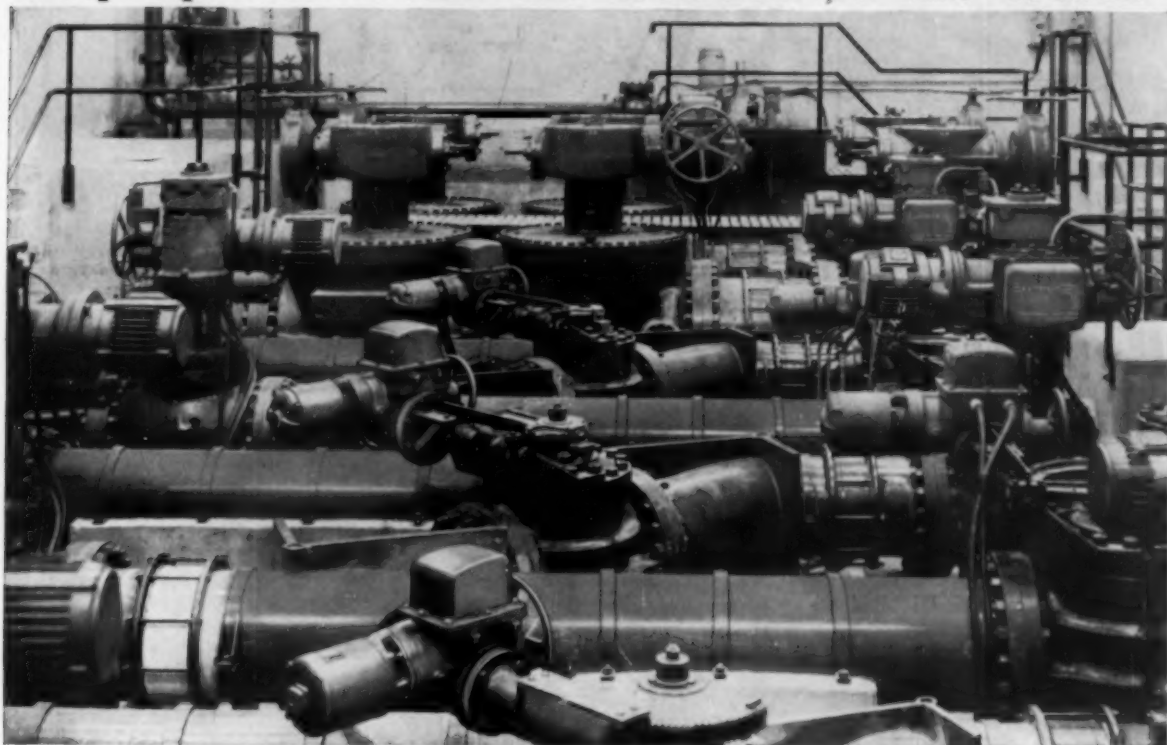
**STEEL PLATE FABRICATORS ASSOCIATION**

105 West Madison Street • Chicago 2, Illinois



# **LimiTorque VALVE CONTROLS**

help operate "The 8th Wonder of the World"



## **COVINA PRESSURE REGULATING STRUCTURE**

**... one of several such structures in a distribution system supplying water to 7,500,000 people in 91 cities**



Be sure to send for Bulletins #1-60 and #19-60 which illustrate and describe the construction, operation and installation of LimiTorque.

This huge water system, selected by the American Society of Civil Engineers as one of the "Engineering Wonders of the World" and operated by the Metropolitan Water District of Southern California, supplies water to 7,500,000 people in 91 incorporated cities over an area of 3,400 square miles in six counties . . . It was built at a cost of approximately \$400,000,000 and has the capacity to deliver 1,212,000 acre-feet of water annually. Its intake is on Lake Havasu formed by Parker Dam on the Colorado River, 300 miles from the City of Los Angeles. Many hundreds of LimiTorque Operators are used on all types of Gate, Globe, Butterfly, Plug and Cone Valves throughout this tremendous water system . . . Twenty-two LimiTorque Valve Controls alone are used in this Pressure Regulating Structure, for operating Plug and Cone Valves made by well-known manufacturers.

LimiTorque Operators were chosen because of their accuracy, safety, absolute dependability, and ease of push-button control from local or remote locations.

For specific applications, consult your valve manufacturer or nearest LimiTorque Sales-Engineering Office.

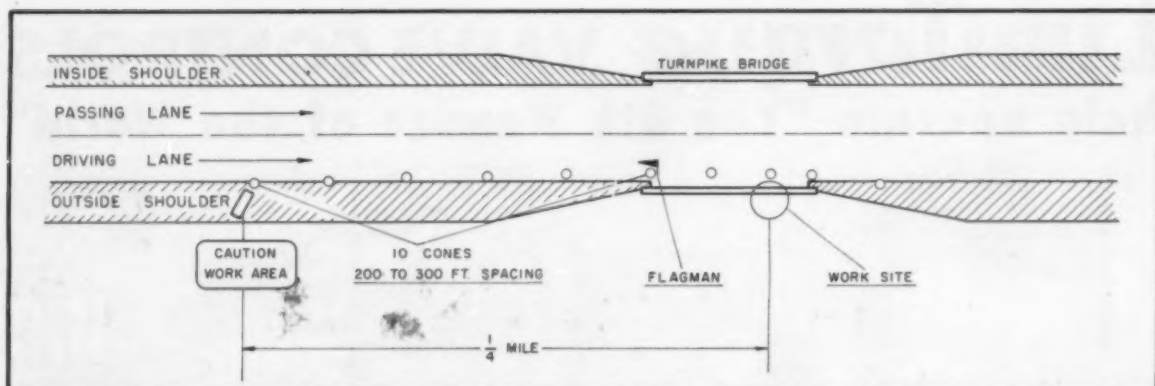
THERE IS NO SUBSTITUTE FOR -  
**LimiTorque®**

**PHILADELPHIA GEAR CORPORATION**  
KING OF PRUSSIA (SUBURBAN PHILADELPHIA), PA.

Offices in all Principal Cities

**INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS**  
LimiTorque Corporation • King of Prussia, Penna.





● STANDARD repair zone signing used by the Ohio Turnpike Commission to protect workmen engaged in bridge maintenance.

## Repair Zone Signing and Protection

**B. H. BOWMAN**

Traffic and Safety Engineer,  
Ohio Turnpike Commission,  
Berea, Ohio

WITH THE advent of turnpikes and other divided limited-access highways, an entirely different character to repair zone signing and protective devices had to be developed for use in properly maintaining these high-speed facilities. Whether the multi-natured work was accomplished by force account or contract, it was necessary that the same procedures be followed in the interest of uniformity if they were to be effective. Where constant high-speed traffic conditions existed, with drivers who were prone to have forgotten how to slow down, the problem on the new expressway type of facility was critical. Maintenance and contract personnel had to work safely and, at the same time, afford the expressway driver with as much safety and protection as possible.

Actually, the concept of repair zone signing had to follow that used in designing the new and modern type of general signing employed on turnpikes and the newly-opened portions of the Interstate Highway System.

The important features of modern general highway signing that are readily adaptable to repair zone signing are: 1) Sign messages need to be short, concise and objective; 2) the messages need to be reflectorized, large, and displayed against a proportionately large background; 3) the first signing on the approach to a critical area must start not less than two miles in

advance; and 4) the warning must be repeated on signs not less than three more times before the area is reached. These are probably the most important considerations that need to be applied to repair zone signing when one lane of traffic is materially affected by required roadway work.

In addition to appropriate signs, the liberal use of 28-in. high yellow traffic cones has proved to be very effective on the Ohio Turnpike. For instance, in diverting traffic from one lane to another, a diagonal one-half-mile long line of cones, spaced at 200-ft. intervals, has achieved the necessary results without mishap. Every attempt is made to arrange work on the traveled concrete roadway itself so that a lane is not closed overnight. However, for obvious reasons this is not possible when a major concrete slab repair is being made. For the hours of darkness, a kerosene pot torch is placed on the ground, approximately 20 ft. in front of each advance-warning sign. In addition to the pot torches, two portable generators are used to supply electric current for a long string of flashing amber incandescent lamps. These are mounted on top of the traffic cones which form the diagonal line used to divert traffic into the open lane. This warning procedure has been successful and no incidents have occurred at night in these locations.

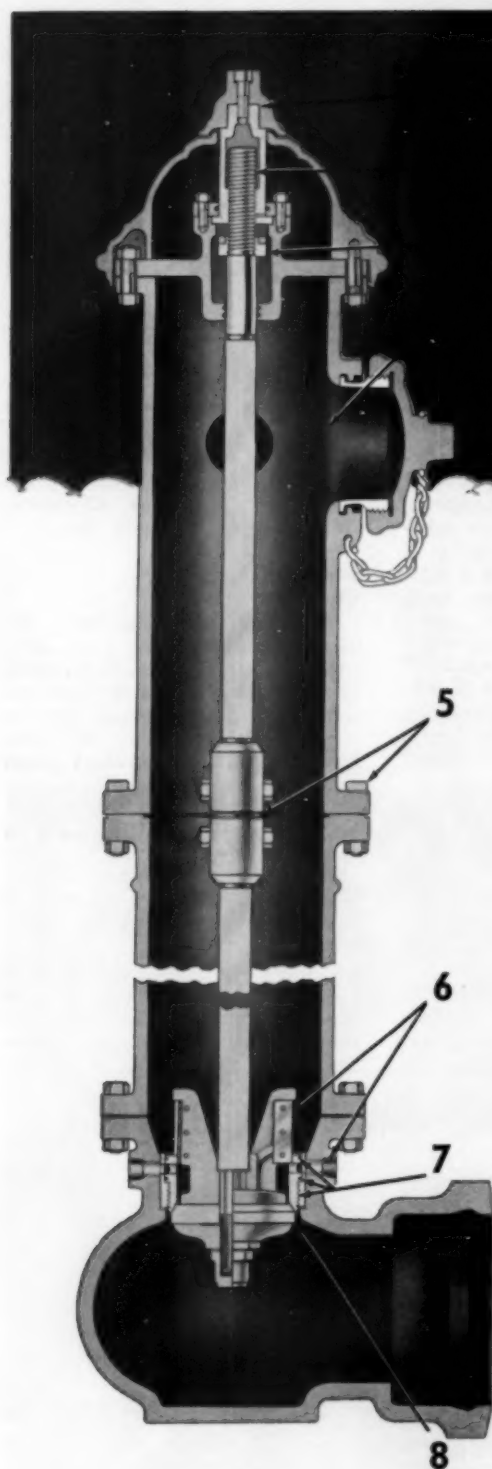
All mobile maintenance vehicles are painted a bright federal yellow, to make them as visible as possible. Each such vehicle has installed, high over the cab, an effective rotary beam flashing light. Personnel, particularly flagmen, are furnished with bright orange-red "day-glo" vests

to be worn whenever employed close to the moving stream of traffic.

The maintenance forces employed on the 241-mile long Ohio Turnpike work out of eight different maintenance buildings located along the turnpike. The normal number of full-time maintenance employees is 210. On a bulletin board in each maintenance building is displayed a large print which shows graphically the proper repair zone signing for the various types of maintenance and repair work. Also, each employee is issued a written manual showing the proper repair zone signing and general protective and safety measures to be followed. Each workman is required to read the manual and verify such reading by his signature. All supervisory personnel are responsible for strict compliance by their forces with the rules and regulations set forth in the manual.

Today's expressways, with their "designed-in" safety and protection, require the same high type of safety and protection for the efficient men and machines that keep these facilities in excellent condition. Through approximately five years of operation, the Ohio Turnpike has not sustained a fatality or serious personal injury to a maintenance employee as a result of a traffic accident.





AS  
ADVANCED  
AS  
TOMORROW...



**NEW!**

## SMITH MODEL H100 HYDRANT

proudly joins the time-proven Smith product line. No other hydrant has ALL these features:

1. **OPERATING NUT:** weatherproof and tamperproof.
2. **OPERATING MECHANISM:** sealed with "O" Rings, operating threads and bearing surfaces permanently lubricated.
3. **TRAVEL STOP NUT:** prevents bending rod if operating torque is excessive.
4. **MAXIMUM DELIVERY:** streamlined openings and large standpipe area reduce friction to minimum.
5. **SAFETY CONSTRUCTION:** if struck forceably, rod coupling and the frangible bolts break cleanly preventing standpipe damage. Groundline flanges permit rotating nozzles to desired position.
6. **POSITIVE DRAINAGE:** corrosion-proof multiport drain mechanism operates automatically. Drain ports momentarily flushed each time hydrant is operated.
7. **VALVE ASSEMBLY:** bronze-to-bronze thread engagement and self-sealing "O" Ring Valve construction permits easy removal of internal parts through standpipe using compact lightweight wrench.
8. **COMPRESSION VALVE:** closes with the pressure — flooding cannot occur under impact.

These and many other important operating and maintenance features are detailed in Bulletin H100 — available on request.

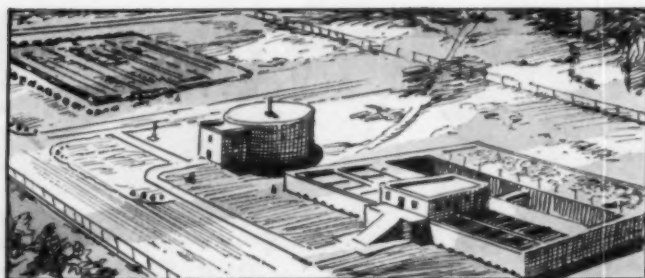
THE A.P. **SMITH** MFG CO.

EAST ORANGE

NEW JERSEY



# THE SEWERAGE AND REFUSE DIGEST



Prepared by ALVIN R. JACOBSON, Ph.D.

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

## Operation at Baltimore

This article recounts the various improvements that have been made and the operating results and the problems encountered from 1948 to 1959, inclusive, at the Back River sewage treatment works, which serves the major portion of Baltimore City and a large part of Baltimore County with a present population of 1,302,000. This sewage works has been unique in many ways: 1) It was the first plant in the U. S. to adopt separate sludge digestion on a large scale; 2) the trickling filters which covered 30 acres when they were completed in 1915 were and still remain the largest in the Western Hemisphere; 3) the first heat-type sludge drying plant in the U. S. was put in operation in 1916 at Back River; 4) this plant was among the first in this country where experiments were conducted a) to determine the practicability of grinding sewage screenings, b) to determine if garbage could be digested satisfactorily with sewage sludge, and c) to investigate the possibility of dewatering digested sludge by vacuum filtration; 5) the elutriation of sludge was discovered by Genter and first investigated at the Back River plant; 6) the plant is unique in the large volume of effluent that is utilized and sold for industrial purposes, the return from the sale of the effluent over the past 12 years has amounted to \$460,000.

"Improvements and Operation at Baltimore's Back River Sewage Works." By C. E. Keefer, Sewerage Engineer, Bureau of Sewers, Baltimore, Md. *Journal WPCF*, January, 1961.

## ABS Determination

The concentration of the alkyl benzene sulfonates (ABS) in wastewater and surface waters can be

determined only if unequivocal analytical schemes are available. Most of the methods now used to measure ABS concentrations in dilute solutions are based on the extraction of a dye salt of the ABS into an organic layer, the ABS concentration being measured by colorimetric techniques. In this article an extractive infrared method for unequivocal analysis of ABS in sewage is outlined. It is a fairly long procedure, though not complicated. Its length is not believed to be a major disadvantage because it is meant primarily as a referee method. Under most field conditions, it is believed that a simple colorimetric method is entirely adequate; however, where unusually high results are obtained by a simple method, this referee procedure should be used to check results.

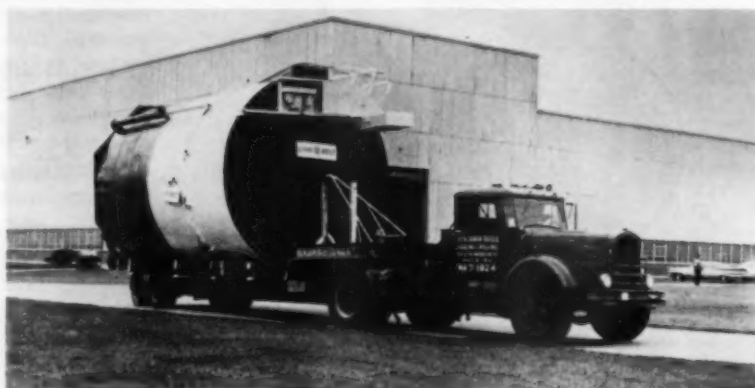
"Determination of Alkyl Benzene Sulfonates in Sewage." By Analytical Subcommittee of the Technical

Advisory Council, Association of American Soap and Glycerine Producers, Inc. R. House, Chairman. *Journal WPCF*, January, 1961.

## European Composting

In Europe the composting of domestic wastes has been much more widespread than in the U. S., there being literally scores of municipal composting plants of one type or another. For example, 20 Dano Egsetor (grinding screening) plants were built in Europe, generally from 1938 to 1955, and 24 Dano biostabilizer plants have been built or placed under construction since 1953 (32 world-wide). In the Netherlands alone, there are 13 compost works serving 22 cities with a population of 1.7 million and treating about 25 percent of the total municipal refuse by three different processes. The three-fold reasons for composting, varying with each coun-

## Sewage Treatment Plant in Transit



Courtesy Link-Belt Company

● COMPLETE, two-stage trickling filter sewage treatment plant, readied for shipment, is designed to serve 200 people, processing 18,000 gpd. This Bio-Pac is 13 ft. in diameter, 22 ft. 3 in. long and weighs 34,000 lbs. At the installation site it becomes operative by hooking up wiring and piping and by adding rock to the filters.



# On Guard

*against pollution with P.F.T. equipment  
at Bethel, Pennsylvania*

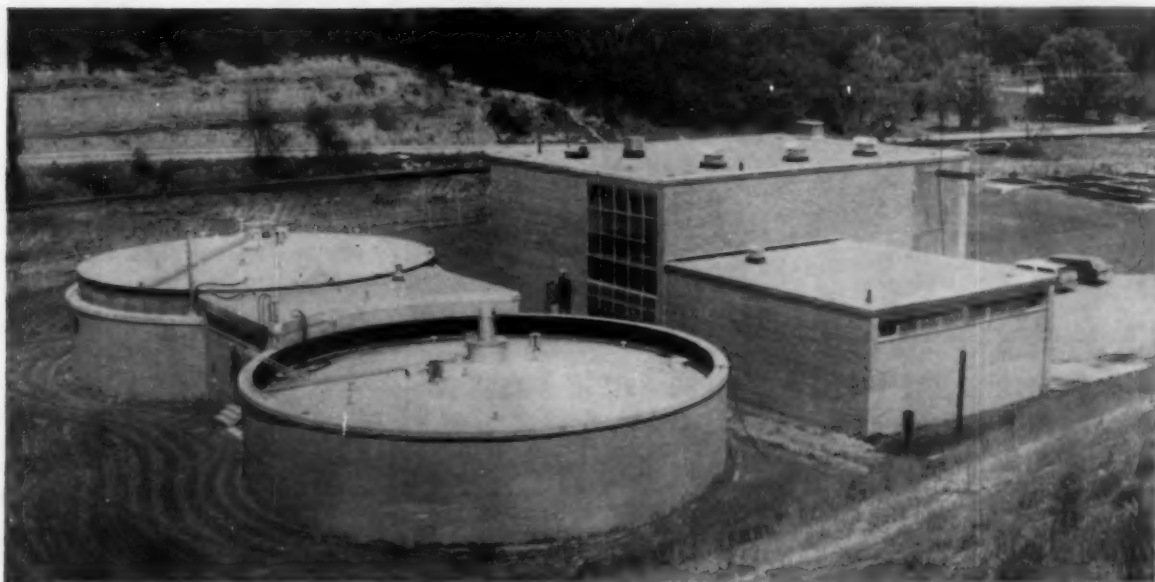


The Borough of Bethel, Pennsylvania has become the fifth largest borough in population in the entire state even though it is only 65% developed.

Rapidly expanding, 400 new homes being built each year and increasing numbers of new industries moving into this area, Bethel's civic leaders have recognized the need of an efficient sewage treatment plant.

Today, this modern sewage treatment plant is a major factor in attracting new industries and assuring the healthy growth and development of this area.

The following P.F.T. equipment is giving Bethel a plant providing an effective and important health-guard for this community. 1 P.F.T. 55' Floating Cover, 1 P.F.T. 55' Spiral Guided Gas Holder; both provided with a P.F.T. Gas Recirculation System, P.F.T. Insulated Aluminum Roofing, 2 P.F.T. Liquidometer Cover Position Indicators with High and Low Level Alarms, 1 P.F.T. #750 Heater and Heat Exchanger Unit and P.F.T. Gas Safety Equipment.



Bethel's Sewage Treatment Plant Designed by Chester Engineers, Consulting Engineers, Pittsburgh, Pa.



waste treatment equipment exclusively since 1893

**PACIFIC FLUSH TANK CO.**

4241 RAVENSWOOD AVENUE, CHICAGO 13, ILLINOIS

PORT CHESTER, N.Y. • SAN MATEO, CALIF. • CHARLOTTE, N.C. • JACKSONVILLE • DENVER

PUBLIC WORKS for March, 1961

165

try as to importance, are sanitary waste disposal, agriculture and economy. The compost has not replaced, but complements commercial fertilizers. Compost is applied only every three or more years to a given area while the commercial fertilizer is generally applied on a yearly basis. Most municipal composting plants in Europe utilize either refuse or refuse and sewage sludge, the latter being raw or digested. The many "systems" of composting municipal wastes may be generally classified into three process types: 1) Open windrow, pile,

or ventilated bin or pit composting with turning; 2) composting in ventilated cells or units with intermittent disturbance; 3) composting in mechanical units with continuous mixing and positive aeration. The various systems are described and some of the problems as well as advantages of the different systems are given. In general, European practice is to compost in publicly owned and operated plants, selling the compost in bulk at the plant at less than \$5.00 per ton, and making no attempt to profit on refuse disposal.

"A Look at European Composting." By John S. Wiley, Sanitary Engineer, Technical Development Laboratories, Technology Branch, Communicable Disease Center, Public Health Service, HEW, Savannah, PUBLIC WORKS, February, 1961.

### Evolution of a Sewage Plant

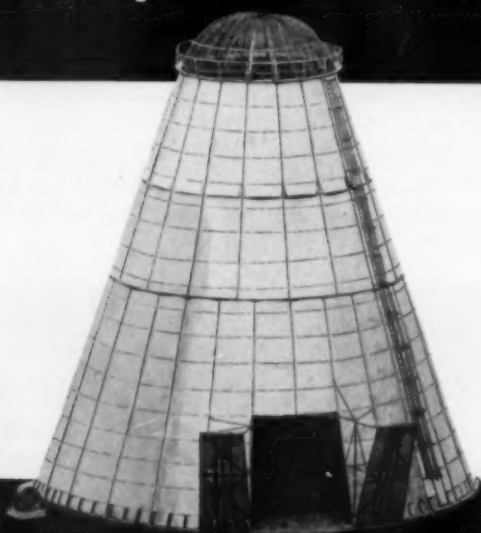
The Akron, Ohio, sewage treatment plant comes close to being an example of "tailoring" a treatment works to a community's wastes discharges by changing the functions of its original processes and adding new ones as design practices matured. The first sewage treatment plant was placed in operation in 1916 and since that time the following modernization steps have made it a prototype of sewage works progress: 1) Primary settling units added to assist Imhoff tanks; 2) sludge digestion tanks added to handle one-half of the plant load; 3) vacuum filters installed to replace sludge lagoons, which had replaced original sludge drying beds; 4) sludge conditioned through elutriation and chemical treatment; 5) sludge filter cake incinerated in multiple-hearth; 6) sludge gas collected, stored and utilized for plant operation purposes; 7) activated sludge processes replaced spray-type trickling filter; 8) grit removal equipment expanded and modernized; 9) thickening tanks added to raise sludge concentration to 7 to 8 percent; and 10) digestion tank mixing planned. Within the next 10 years, better instruments and more automation can be expected. The author believes that the latter can be overdone and its installation should be related to saving of operating costs, to better control or to equipment protection.

"Evolution of a Sewage Plant." By Ralph J. Bushee, Superintendent of Sewerage, Akron, Ohio. *Wastes Engineering*, January, 1961.

### Bulk Refuse Collection

In 1955 the Department of Sanitation of the City of New York instituted a special collection service for bulky discarded objects such as bed springs, refrigerators, stoves, etc. Usually this class of refuse had found its way into vacant lots, areas and other vacant spaces where it was dumped and forgotten. The program was started with a makeshift fleet of old refuse trucks which were cut down into open dump trucks. It was soon realized that it was essential to purchase new equipment specifically designed for

## Wilco Teepee Refuse Burner®



## Extends Landfill Life

Operators report the Wilco Teepee Refuse Burner is capable of increasing landfill life up to 85 per cent.

**EFFICIENT** — Exclusive Triple Draft system promotes fast, clean burning and combustion . . . continuous burning, not restricted to time cycle . . . effective disposal for demolition lumber, industrial wastes, cartons and crates, tree stumps, trunks and branches, furniture, mattresses and refrigerators.

**ECONOMICAL** — Low initial cost . . . low operating cost . . . low maintenance . . . no special operator required . . . auxiliary fuel not required.

**SAFE** — Underwriters approved . . . totally enclosed burning area . . . adjustable under-fire draft . . . spark arrester mesh in dome . . . air cooled liner dissipates heat.

Unit illustrated above is Model 675 — largest of 10 available sizes. Write for detailed information.



**wilco machine works, inc.**

P. O. Box 3897, PW-1 Memphis 14, Tenn. WH 8-4555



## Shively Ky. LOUISVILLE

Fourteen Smith & Loveless factory-built sewage lift stations are a part of the new municipal sewerage system in Shively, Kentucky. The project was engineered by J. Stephen Watkins and Robert E. Martin, consulting engineers of Louisville and Lexington, Ky. The stations were installed by Hy-Ty-Co, a joint venture of the R. B. Tyler Company of Louisville and Hyde Construction Co., Jackson, Miss.

Shively is the fastest-growing city in Kentucky and a suburb of Louisville. Its new sewer system will utilize eight Smith & Loveless pump stations—seven with elevators in the entrance tube—and six Smith & Loveless "Mon-O-Ject" pneumatic ejector lift stations.

The Shively stations are another vital link in our list of over 1,600 installations all across the United States, including Alaska and Hawaii, Canada—even Europe and South America. Built by the world's largest manufacturer of factory-built sewage lift stations for municipal sewerage systems.

## Smith & Loveless



P. O. BOX 8884 / KANSAS CITY 15, MISSOURI / PLANT: LENEXA, KANSAS

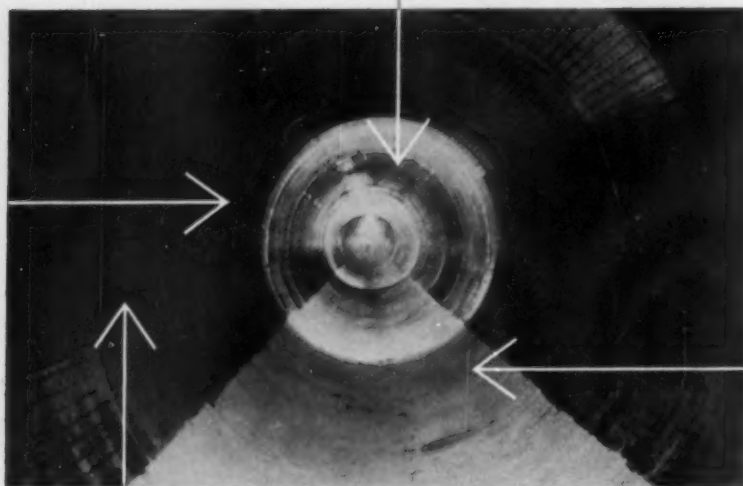


For the complete story of Shively's municipal sewerage system—and engineering data on Smith & Loveless factory-built sewage lift stations and sewage treatment plants—just write to Department 40.





# take a LONG LOOK at sewer linings



## *It's a Hundred Year Proposition*

This 9½-foot outfall sewer extends eight miles, and it will go a long way in years of trouble-free service. The engineers who designed it say that it will still be functioning perfectly well into the 21st Century. One important reason is that every surface above the low flow line is completely covered by a continuous membrane of T-Lock Amer-Plate, the vinyl lining that is impervious to chemical effluents and to the corrosive action of oxidized hydrogen sulfide at any level of concentration.

Engineers know that no one can accurately predict future rates of H<sub>2</sub>S gas generation, so they have insured the ultimate life of the concrete by investing an extra 8 to 10% for the absolute protection afforded by T-Lock. They predict that this will spare their city the cost of a replacement sewer in about 20 years, and save the taxpayers millions of dollars!

Where protection is required, only T-Lock is satisfactory because only T-Lock combines complete chemical imperviousness with integral T-ribbed back which mechanically locks into the concrete. Experienced sewer design engineers will not gamble on compromise methods. Millions of square feet of T-Lock are now in use in Los Angeles; Topeka; Wichita; Sioux City; Shreveport; Washington, D.C.; San Diego; Mansfield, Ohio; Huntington, W. Va.; Hutchinson, Kansas; and Orange County, Calif. T-Lock Amer-Plate is also on current specifications for many other municipalities. For complete list of users and specifiers, plus technical data and a typical specification, write:



Dept. BO, 4609 Firestone Blvd.  
South Gate, California

921 Pitner Ave.  
Evanston, Ill.

360 Carnegie Ave.  
Kenilworth, N.J.

111 Colgate  
Buffalo, N.Y.

2404 Dennis St.  
Jacksonville, Fla.

6530 Supply Row  
Houston, Tex.

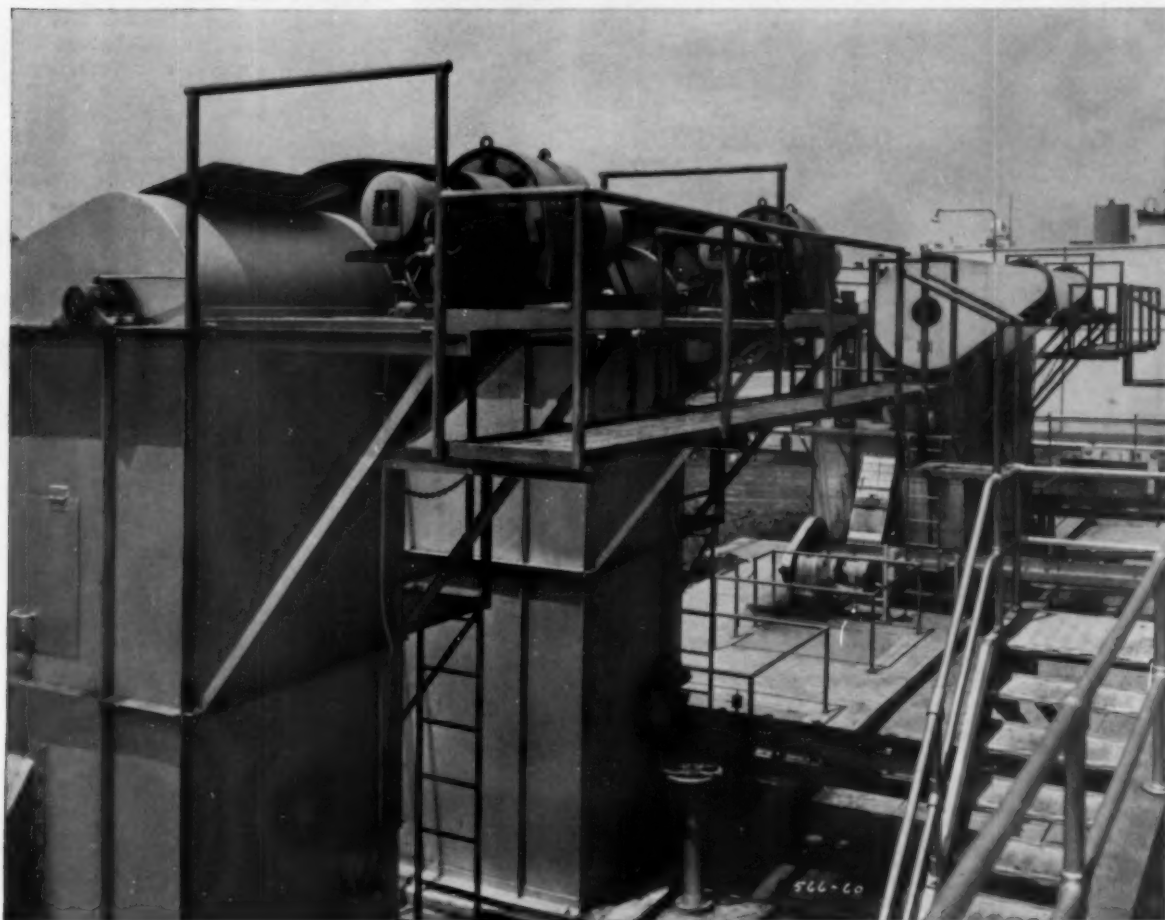
bulk collection and other uses. When funds became available 20 new trucks were purchased, each having an International Harvester chassis and a Daybrook body and tailgate. Twenty-five additional units are to be delivered in 1961, each with a 32,000 pound gross weight chassis and a dump body with hoist and hydraulic tailgate. The hydraulic powered tailgate, operating from a separate power-take-off connection, has at least 2,000 lbs. direct lifting capacity with controls on each side of the rear of the body. The tailgate provides a loading platform approximately 91 inches by 41 inches and can function as a: 1) Direct lift power gate for handling and loading heavy bulk objects; 2) standard dump body tailgate in the locked body position since it is provided with a top hung inner section approximately 35 inches high for dumping salt or other materials into restricted areas by raising the dump body only; 3) locked tailgate, extended from the body floor line for dump body floor extension, for use in dumping material in piles on the ground while the vehicle moves forward away from the piles. The quantity of bulky discarded objects collected annually has increased from 34,213 tons in 1955 to 74,250 tons in 1959.

"Bulk Refuse Collection Helps Keep New York Clean." Paul R. Screvane, Commissioner, Department of Sanitation, New York. PUBLIC WORKS, February, 1961.

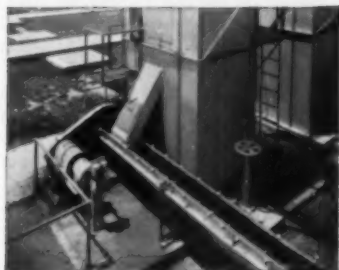
### **Discharge of Sewage into the Sea**

Many coastal towns have adopted the practice of discharging sewage, either crude or only partially treated, into the sea. However, the public has become much more aware of this practice and is demanding that extensive offshore pollution does not result. The degree of pollution which can be tolerated in any given situation must be viewed from the three standpoints of health, aesthetics and economics. In the case of sewage discharge into the sea, it tends to spread out at the surface so that contact with the diluting sea water occurs at only one interface. In addition, there is a lesser potential oxygen availability due to the fact that sea water contains about 20 per cent less dissolved oxygen than fresh water. On the other hand, the presence of a free surface enables oxygen to be directly absorbed from the atmosphere. It is generally accepted that sea water is a less efficient purifying medium than fresh water, although it seems to have a superior bactericidal effect.

*At District of Columbia's Sewage Treatment Plant...*



*Designed by Metcalf & Eddy, Consulting Engineers.*



## **4 JEFFREY Heavy Duty V-Bucket Collectors dispose of 120 cubic feet of grit per hour**

V-buckets, traveling through the aerated grit channels, pick up the grit. At the influent end of the channel, the grit is elevated and the buckets are discharged as they pass over the head sprocket; the buckets are perforated to allow the free water to drain back into the channel. Grit falls into the spiral cross-conveyor, which carries it to the storage area.

Jeffrey supplies grit collectors to suit any local conditions; the scraper type, the elevator-spiral

type or the V-bucket type shown here. Type and size are determined by the amounts of grit and flows expected, space available for equipment, and the organic matter encountered. Jeffrey sanitation engineers can advise you on equipment to suit your conditions.

For a copy of Bulletin 952 describing Jeffrey equipment for water, sewage and industrial waste treatment, write The Jeffrey Manufacturing Co., 947 N. Fourth St., Columbus 16, Ohio.

CONVEYING • PROCESSING • MINING EQUIPMENT...  
TRANSMISSION MACHINERY...CONTRACT MANUFACTURING



**JEFFREY**



## DIXON PAINTS LAST LONGER

This water tank shown is in Yonkers, New York and was painted over 15 years ago with Dixon paints. It's still getting good protection from sun, snow, sleet and rain!

This is not an unusual record for Dixon paints which, when properly applied, double normal paint life. This is proven out by Dixon customer records dating back for over 60 years. Cut your maintenance costs and give your water tank longer life with Dixon paint.

### DIXON SILICA-GRAPHITE PAINTS FOR WATER TANK INTERIORS

These paints, which will not add odor, taste or color to the water, give maximum protection to the interior of your tank. When the tank expands and contracts the paint will not flake or crack because the interior paints, like the exterior paints, contain flake Silica-Graphite.

SEND COUPON TODAY FOR INFORMATION  
THAT WILL SAVE YOU MONEY!

# DIXON

JOSEPH DIXON CRUCIBLE CO. Jersey City 3, N. J.

Paint Products Division, Dept. PW-3

Gentlemen:

- ☐ Please send free sample contract forms and specifications which will enable me to get a quality paint job for less money.  
☐ Please send me a FREE copy of brochure "ENGINEERED PROTECTIVE MAINTENANCE for the Water Industry" (V-90)

Name \_\_\_\_\_ Title \_\_\_\_\_  
Organization \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



**DIXON PROTECTS BRIDGES TOO!** New York's famous Palisades Highway was painted with Dixon Paint in 1932 and didn't need repainting until 1942! This is because heavy industrial paints, and the most extreme weather conditions, cannot harm Dixon. After more critical tests of long lasting paint jobs than any other paint manufacturer.

Disintegrators and comminutors are used to grind up the solids in sewage before final discharge into the sea. In those situations where the effluent must be of a higher quality, sedimentation tanks may be required. Further stages of treatment may be introduced, but in general will not be found necessary or economically justifiable. When sewage emerges from a pipe outlet near the sea bed, it rises to the surface and spreads out in a horizontal layer or relatively shallow depth. With very large discharges a system of multiple discharges, called diffusers, is provided at or near the end of the main outfall pipe, which serves to enlarge the outlet field. Purification proceeds by physical, chemical and biological processes, the main requirement for inoffensive decomposition being an adequate supply of oxygen in order to facilitate reaeration. Waves are beneficial, since there is an orbital motion of the water particles, which promote a moderate degree of turbulence and a reduction in stratification. In addition, air is entrained at the surface which assists in reaeration of the sewage. The location of outfalls in estuaries are discussed in considerable detail in this excellent article and the author concludes with a discussion of the various methods of ascertaining the probable behavior of a sewage field in an effort to determine the best location for a sewage outfall. The most efficient outfall scheme is the one which achieves the desired freedom from pollution at the minimum cost.

"The Discharge of Sewage into the Sea." By N. B. Webber, B.Sc. (Eng.) A.M.I.C.E., A.M.I. Mun. E., Lecturer in Hydraulics, Dept. of Civil Engineering, Southampton University, England. *The Surveyor and Municipal and County Engineer*, (London), December 17, 1960.

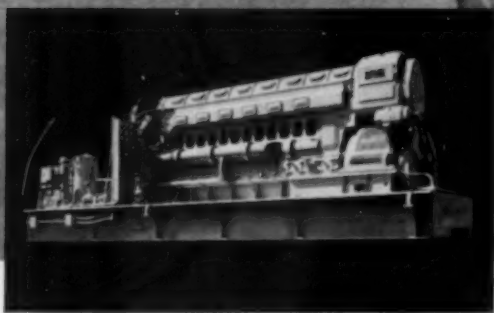
### Other Articles

"Disposal of Radioactive Wastes into Deep Geologic Formation." The injection of radioactive wastes into deep geologic formations is considered a feasible and economic approach to handling low- and intermediate-level wastes. By Warren J. Kaufman, Associate Professor, University of California, Berkeley, Calif.; Ben F. Ewing, Associate Professor, University of Illinois, Urbana, Ill.; James V. Kerrigan, Assistant Research Chemist, and Yori-teru Inoue, Graduate Research Engineer, University of Calif., Berkeley, Calif. *Journal WPCF*, January, 1961.

"Determining the Pattern of the Diatom Flora." The short method described, called a semi-detailed reading, can be used to estimate reliably the structure (Please turn to page 196)



# NOW! FULL POWER IS 15 SECONDS FAST!



Solve peak-load and standby problems! F-M's exclusive O-P Diesel Generating Units provide *full* power in 15 short seconds . . . *from a cold start!* They need no spinning reserve. Use no power till you use them! The reason? Our exclusive O-P (Opposed-Piston) design. Two pistons in one cylinder function from a *single* combustion. This minimizes *vibration* . . . produces fine *balance*, *smooth* power to peak the generator—in just 15 seconds! F-M Opposed-Piston Diesel Generating Units are available with automatic or manual controls. Produce up to 2500 kw. They may be linked in multiple units for peaking, standby duty . . . or dead load pickup! You can't buy better—or more economically.

For full details or custom specifications, write today to: **Mr. S. K. Howard;**  
**Diesel Division; Fairbanks, Morse & Co.; Beloit, Wisconsin.**

**FAIRBANKS MORSE**  
A MAJOR INDUSTRIAL COMPONENT OF  
**FAIRBANKS WHITNEY**

## COMMUNITY RENEWAL PLANNING IN NEW JERSEY

**T**WO NEW programs of financial and technical aid to the municipalities of New Jersey have been announced. Commissioner Salvatore A. Bontempo of the Department of Conservation and Economic Development has developed a program of assistance for continuing planning and a program of assistance for community renewal programming to be administered by his Department.

The State is prepared to assume part of the burden facing local planning boards which have wanted to engage in continuing planning but have lacked the financial and technical resources to do so. Simultaneously, a parallel and companion Community Renewal Program, also has been established. Taken together, the two programs permit the State to begin to explore measures by which it could assume a constructive role as a full-time participant in urban renewal.

Municipalities are given the opportunity to contract for a period of years with the State for such assistance. In the first year of the contract the State will advance up to 50 percent of the cost of an agreed-upon continuing planning program; in the second year, 40 percent; in the third year 30 percent, etc.

If during this period the municipality continues to maintain the program, then all advances will be considered grants by the State, and the municipalities need not repay them. If, however, the program has been discontinued at any point during the five-year period, the State's advances must be repaid.

One of the program's chief purposes is to stimulate local interest in continuous planning, and to encourage municipalities to adopt planning as a permanent function of local government. Once continuing planning has been in existence for five years, State officials are confident that local government will maintain it, for it will have had sufficient time to demonstrate its value. Moreover, such planning would lend continuity and stability to master planning regardless of the normal changeover in local government. The State does not propose to maintain the Continuing Planning Program to any one municipality indefinitely, as a new function of State government to be perpetuated. Rather, it conceives its function in

this area as being to stimulate, educate, consolidate and then withdraw, leaving the financing entirely to local government. The State, through its Planning Bureau will continue to provide advisory services.

Community Renewal Programs are not as general as master plans nor specific enough to outline projects in the great detail which is necessary before any actual clearance and construction can begin. Their basic purpose, according to the Federal Housing and Home Finance Agency, "is to identify and measure, in broad terms, the total need for urban renewal action in the community, to relate this need to the resources available to the community, and to develop a long

range program for urban renewal action."

Community Renewal Programs will cover a city as a whole. They will attempt to determine what needs to be done and in what priority. They will not describe specific projects, but, when completed, will make it much easier for technical consultants to proceed effectively with the transition to project plans.

Only municipalities which have completed and promulgated their master plans are eligible to receive federal grants. Two-thirds of the cost of a Community Renewal Program is provided by the federal government; the remaining one-third by the municipality.

Aware of the financial strains to which municipalities have been subjected, the State has entered the federal program as a contributor. It proposes to provide one-third of the municipality's share of the cost.

## EXPANDED PAVEMENT MARKING PROGRAM



**T**O MEET the growing needs for year-round street traffic markings and to take over marking of the Youngstown Municipal Airport, the Traffic Engineering Department of Youngstown, Ohio, has recently added a Wald "Statesman" pavement marking unit to its equipment fleet. John F. Pletnik, Traffic Coordinator, says that with the new unit his department can accomplish the city's annual marking program in less than half the time formerly required, with the same or less manpower. Two smaller Wald machines owned by the city will be continued in use to extend markings to areas not presently striped and to increase crosswalk marking.

Youngstown marks its streets with two colors, white and yellow,

using in many instances a double yellow center line with a white skip line in between. It puts down about 500 to 600 miles of line a year, including some heavily traveled streets that are marked twice a year.

The marking unit, which can put down three lines simultaneously, using both white and yellow, has three high speed spray guns with glass sphere dispensers for drop-on. The guns and dispensers are operated by push-button control from the cab or from a position on the rear of the unit. Included are two 80-gallon paint tanks and a 750-pound glass sphere tank. An optical sight replaces the long pointer arm which formerly projected far in advance of the striping units.

For Materials Handling or Refuse Collection

# DINOSAUR + DINOMASTER

Handles (in addition to DINOMASTER) containers eight through 40 cu. yd. capacity and over



When mounted on DINOSAUR, provides "No-Container-Haul" Service for refuse containers, one through eight cu. yds.



Besides serving DINOMASTER, the DINOSAUR picks up huge loads in big capacity containers . . .



extremely heavy materials in smaller containers . . .



. . . and can even handle two containers at a time for additional flexibility.

DINOSAUR picks up DINOMASTER hydraulically for refuse container service.



DINOMASTER engages loaded container and lifts it into emptying position.



Contents fall into body where up to 85,000 lb.\* pressure packer plate compresses material to a fraction of its former volume.



Mfd. Only By  
**DEMPSTER BROTHERS**  
Inc.  
Dept. PW-3, KNOXVILLE 17, TENNESSEE

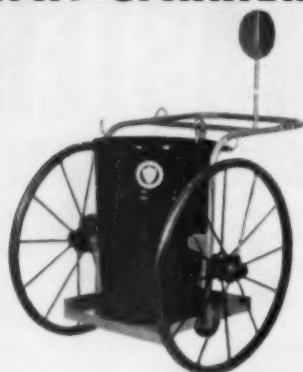
PART OF THE  
**DEMPSTER**  
SYSTEMS®

\*On 30 yd. Model

WRITE TODAY  
FOR  
COMPLETE INFORMATION



## Street Sweepers' CAN CARRIERS



TARCO "Street Sweepers' Friend" Can Carriers are the toughest, best balanced, easiest pushing carts you can buy.

All welded steel construction . . . no bolts, no rivets, no dangling chains. Choice of big, easy-to-push wheels with either pneumatic, solid rubber or plain steel tiring on roller bearings. Full swiveling caster wheel. Silent can-clamp. Tool hooks. Traffic warning flag.

Make it easy on yourself all way round . . . buy longer lasting can carriers that look good; that will be less tiring for your men to push and use. Buy TARCO "Street Sweepers' Friend" Can Carriers. See your nearest TARCO dealer or write for details.

### TARRANT MFG. CO.

28 Jumel Place, Saratoga Springs, N.Y.

**EITHER BY THE  
GLASSFUL, OR THE  
BILLIONS OF GALLONS . . .**

. . . pure water is the lifeline  
of Municipalities and Industry.

For over 60 years, Roberts Filter  
Manufacturing Company has been  
complementing the engineer-  
ing profession in supply-  
ing water purification  
equipment through-  
out the Western  
Hemisphere.

## ROBERTS FILTER

Manufacturing  
Company  
Darby, Pa.

## Model Traffic Interchange Educates Motorists in South Carolina



A SCALE model of one of South Carolina's full clover-leaf traffic interchanges on an interstate highway, with 80 miniature cars slowing down and speeding up, entering and leaving throughways, detail reproductions of signs, overpasses, right-of-way, exits and entrances, took five weeks of ingenious effort by South Carolina Highway Department personnel.

About 1200 feet of roadway was reduced to a scale where one inch equals 10 feet. A quarter-horsepower, electric motor moves chains concealed beneath the pavement. Cars traveling on the throughway move with those entering and leaving via the loops at an 8-11 speed ratio. By calculation, the cars entering never collide with throughway traffic, but speed up and merge into traffic lanes. The cars are attached to the chains by pins.

Timed relays open concealed switches that periodically cause the miniature cars (including several Highway Patrol cars) to move into and slow down in deceleration lanes when leaving the freeway.

The model was designed with the hope that those viewing it would study and learn how traffic interchanges actually work to reduce traffic accidents.

A continuous tape recording over a loudspeaker pointed out features, noting how traffic conflict is eliminated by engineering design, how traffic never meets at sharp angles and how crossings at grade level are absent, that stop signs are omitted, and traffic moves smoothly and orderly.

After display at the State Fair, the exhibit was permanently installed for public display at a Highway Dept. building in Columbia.

## NUMBER OF AUTOMOBILES USED BY COUNTY HIGHWAY DEPARTMENTS

In a questionnaire to County Highway Engineers, Superintendents and similar officials, information on the number of cars used by the Highway Department was asked. Replies from 472 counties showed a total use of 3727 automobiles or an average of 7.88 cars per county, though the actual number reported by the individual counties varied from one to several hundred. Based on 3,058 counties, use by highway departments should total about 24,000 cars.

In response to a question about compact cars, 50 counties reported using 190 such cars. Comments on them ranged from "fine" to "ok" to "I don't like them."

These data are an extension of a preliminary report covering some 246 counties issued some time ago. This report includes the previous data plus information from questionnaire received later. Neither this nor the previous report included automobiles used by county departments other than highways.

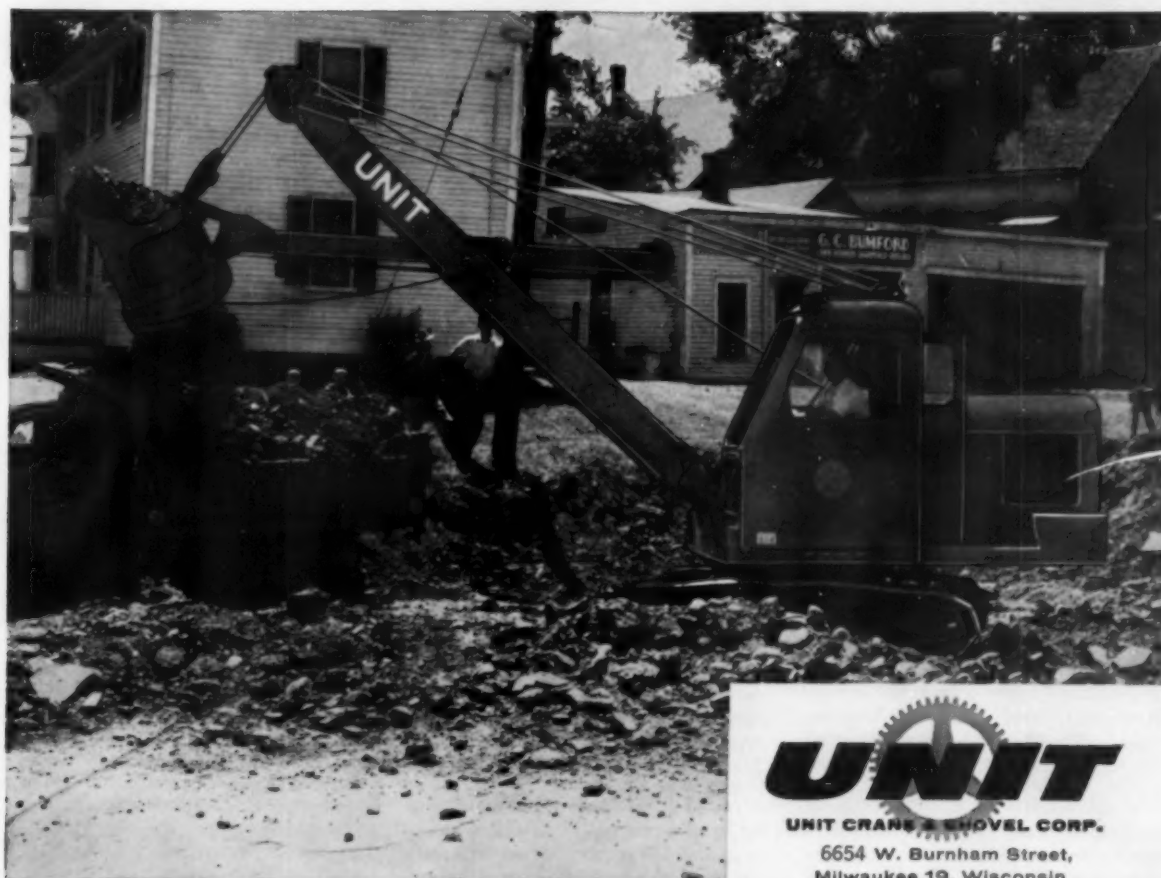
**Low initial price  
OR  
Low final cost**

**?**

In purchasing a crane-excavator for road construction and maintenance, do you look beyond the low bid figure? You should, because the cheapest buy is not necessarily the best buy. Initial purchase price does not reflect final cost of a machine that must be used, serviced, maintained and repaired for many years. Your best buy is the machine that meets all your production requirements with the lowest final cost.

Dollar for dollar a UNIT crane-excavator gives you more in terms of productivity, low upkeep, and built-in dependability. You get more production with UNIT'S *direct-in-line drive* — a simple, highly efficient power transmission system — and smooth-acting disc-type operating clutches. You get low upkeep with UNIT'S *exclusive one-piece main machinery case* completely enclosing all gears, shafts and bearings. Operating in a constant oil bath, they last longer . . . require less maintenance attention because lubrication is continuous. UNIT gives you built-in dependability, too. All spur and bevel gears, worm drives, and rollers are forged for uniform toughness. Shafts are involute splined for greatest strength. Essential working parts are scientifically heat-treated with wear surfaces flame-hardened for long life.

When bids on a crane-excavator are next opened, consider *final costs first*. Do it, and like so many other public officials, you'll choose UNIT. Available on crawlers (½- to 1-yd. size) and on rubber (½- to ¾-yd. size). All models are designed for use as shovel, crane, dragline, trencher, or clamshell.



**UNIT**  
UNIT CRANE & SHOVEL CORP.  
6654 W. Burnham Street,  
Milwaukee 19, Wisconsin

SHOVELS: ½ Yd. to 1 Yd. • DRAGLINES: ½ Yd. to 1 Yd. • TRUCK CRANES: 10 Ton to 40 Ton • TRENCHERS: ½ Yd. to 1 Yd. • CRANES: 5½ Ton to 21 Ton

PUBLIC WORKS for March, 1961

175

# EQUIPMENT OPERATOR TRAINING BOOSTS PRODUCTION

**T**O KEEP PACE with the continuing machine improvements offered by manufacturers, city, county and state public works departments are recognizing the need for operator training programs. They know that the true value of new equipment lies in realizing the productivity that was designed into it.

The equipment operators also have incentives for receiving training, chief among them being: 1) To become highly skilled in the operation of a machine; 2) to become better operators and thus increase their chances of continued employment during slack periods; and 3) to learn how to operate more than one kind of machine to increase their chances of advancement.

The employer of course, benefits from the training program because the skilled operator can get more work out of his machine. Greater productivity means greater economy and more opportunity to accomplish the work programmed. Those public works departments which lack skilled operators face a very real problem. It is sometimes difficult to obtain skilled operators. Wages may be somewhat less than competitive with private employers. Yet, it takes a skilled operator to get the most good out of a piece of equipment. In view of this, a training program to develop skilled operators would seem to be highly desirable.

There are a number of reputable operator-training centers in the United States where an operator can be trained at nominal cost in time and money. The schools offer supervised field operation of equipment, both on practice courses and on actual construction projects. Courses in operation and preventive maintenance range from three to 30 weeks or more in length and are divided into various combinations of equipment. One course, for example, may deal with crawler tractors and scrapers; another, with front-end loaders and shovels; a third, with motor graders alone. Some of the schools are members of the American Road Builders Association and most of them are approved by the State Department of Vocational Education Training.

When money or time for formal school training is not available, a good alternative is for the superintendent to set up an effective training program of his own. There are



● **NUMEROUS** instruction booklets for the equipment operator are offered by manufacturers. Pictured above are typical training aids available from the Caterpillar Tractor Co. If you would like copies, check Box "A" on the card opposite page 34.

a number of points to be considered in developing such a program.

**Facilities.** Equipment storage yards, offices and current job sites can be readily used for academic and on-the-job training.

**Training period.** For maximum effectiveness the program should be held on a weekly or monthly basis and continued throughout the year. A "sometimes only" approach dampens interest, magnifies problems.

**Student-Operators.** Public Works groups must employ inducements for the individual operator such as job security, self-improvement, opportunity for advancement, and the like. Training should be considered an integral part of the operator's job and, if possible, should be done during his work day.

**Instructors.** The program should be handled by someone who will accept the assignment as an interesting challenge and who is experienced in operating one or more pieces of

equipment. Many departments already have skillful operators capable of teaching those less skilled. Additionally, in every community there are public spirited individuals in heavy machinery work who are ready and willing to help, if the problem is properly explained to them and they are given assurance their efforts will be utilized.

**Training aids.** These can be obtained from equipment manufacturers and their dealers, who have literature and films available to help operators do a better job. Operator handbooks and maintenance guides can be obtained on motor graders, tractors, scrapers and front-end loaders.

Caterpillar Tractor Co., for example, has a booklet on motor grader blade positions for its Nos. 14, 12 and 112 graders. The booklet describes and illustrates working positions for the blade in grading, leveling, ditching, shoulder clean-up,



backsloping, ditch clean-up, flat-bottom ditching, reverse blading and extreme positions. Booklets on operating other machinery are also available.

Movies and strip films can be obtained from manufacturers or their dealers on earthmoving fundamentals, operator safety, use of automatic blade controls, blading, bulldozing, preventive maintenance and similar subjects of interest to operators. Finally, equipment catalogs should also be considered a training aid, for they acquaint the operator with machine features and abilities.

Many side benefits accrue from an effective training program. Because a trained operator can get more work out of his machine, the job itself gets done faster, whether it be snow removal, grading, paving or other projects. This means more work can be done by the same machine. Finally, a trained operator means better preventive maintenance, fewer repair costs, less down time. In short, an operator training program gives the city, county or state more for its tax dollars.

#### Communications Network For Garden State Toll Road

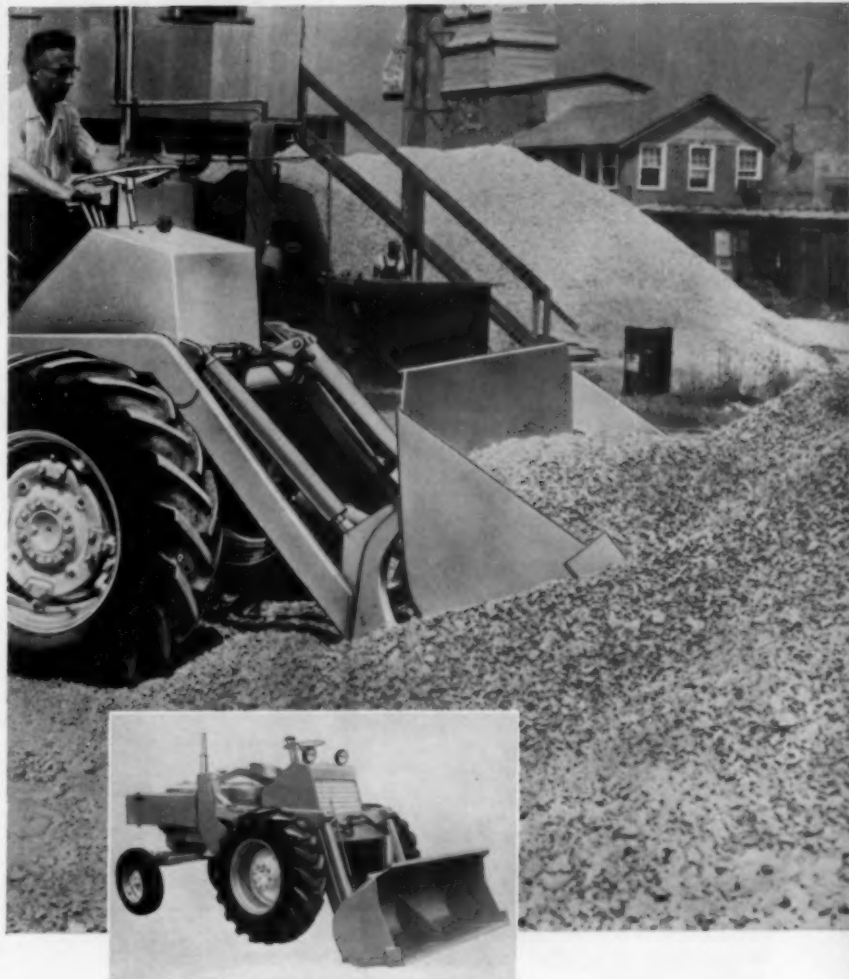
New Jersey's Garden State Parkway has contracted with General Electric Company to supply an integrated mobile radio and microwave network to make its communications the most modern in the nation. Provisions are included for future incorporation of data transmission channels to handle toll road paper work and for remote control channels which could be used for traffic signs.

Basic backbone of the network will be a 120-channel General Electric microwave relay system operating in the 6,000 megacycle range. This will tie together State Police and maintenance crews along the whole toll road length. Under the contract, G-E will supply 131 mobile radio units for use by patrol cars and highway vehicles; also 21 table-model very high frequency base stations and 17 microwave stations to be located at various points along the 173-mile route.

Designed by Ebasco Services Inc., engineering consultants, the microwave-mobile network will have channels for telephone and teletype circuits and for parkway vehicles. All will be linked to a switchboard at the central headquarters in Woodbridge, where the Parkway commission is relocating its headquarters.

PUBLIC WORKS for March, 1961

## BIG WHEELS UNDER THE LOAD!



**FOR** the surprise of your life, watch this Allis-Chalmers D-15 Utility tractor handle a full 1-yard loader bucket! There's greater breakout and lifting capacity because weight of the unit, material and bucket are applied against the *big* wheels! The operator sits high, close to the work where he can see what goes on!

The exclusive self-loading bucket hydraulically rolls up into the material for a heap load on every pass. Then the **SHUTTLE clutch** lets you move out and away fast, without foot-clutching or gear-shifting.

**IT DOESN'T COST TO FIND OUT** why Allis-Chalmers Utility tractors pay off for profit-minded contractors! See your Allis-Chalmers dealer today, or write Allis-Chalmers Mfg. Co., Utility Tractors and Equipment, Milwaukee 1, Wisconsin.

## ALLIS-CHALMERS

# THE INDUSTRIAL WASTE DIGEST



Prepared by **CLAYTON H. BILLINGS**, Associate Editor

## Deep Wells for Radioactive Wastes

Connate waters, those isolated from the hydrologic cycle, are indicated to have had an undisturbed existence for millions of years. This is borne out by the high chloride concentrations and the associated occurrence of petroleum in the formations. The liquid capacities of these sandstones are enormous; they are highly porous and have a cation exchange capacity from the presence of clays; the technology of introducing waste waters into the formations has been highly developed by the petroleum industry. These factors have lent feasibility to the concept of using deep injection as a method for disposal of low and intermediate level radioactive wastes, where surface disposal by dilution is not advisable. Pretreatment of wastes for injection might involve hold-up and blending of wastes of a variable character, followed by chemical precipitation, filtration, pH adjustment and chlorination. The resulting sludges would be highly radioactive, necessitating diversion to handling with other high level wastes or storage separately. An installation for injection of wastes into connate waters would be composed of a grid of injection and relief or monitoring wells. The relief wells, which will allow withdrawal of connate water from the same formation, offer several advantages. They will help maintain the static state, minimizing breakout through the confining formation; they will cause a maximum rate of liquid movement into a well that can be monitored; and input pressures for injection can be reduced. The removed connate water presents a lesser disposal problem and can be handled by surface dilution or by injection to shallower levels. Detailed exploration of a proposed disposal site will require the most advanced geophysical methods, including the drilling of test wells and the use of water

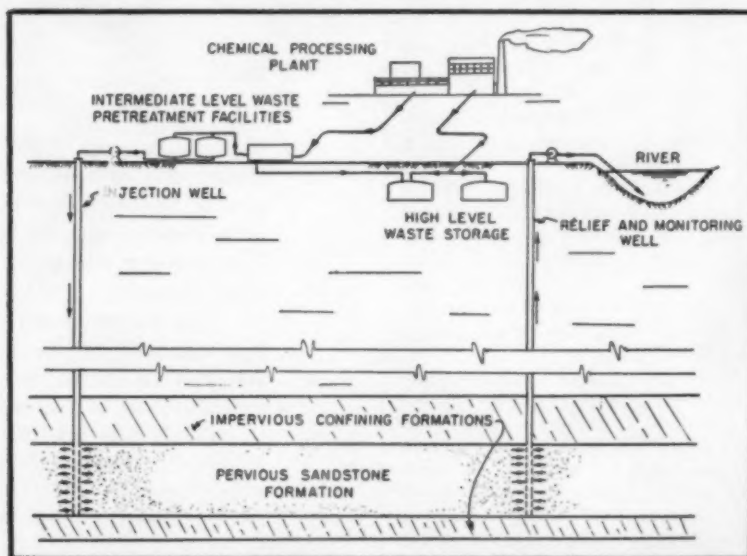
tracers. Information determined by passing typical waste solutions through formation cores in the laboratory, coupled with field measurements of the dispersion properties of the formation, will make possible a completely engineered disposal system, with capacities and costs as calculable quantities.

"Disposal of Radioactive Wastes into Deep Geologic Formation." By W. J. Kaufman, U. of California; Ben B. Ewing, U. of Illinois; and J. V. Kerrigan and Y. Inoue, U. of California. *Journal WPCF*, January, 1961.

## Chromium and Activated Sludge

The data in the literature on the effect of metals on biological processes have largely been developed by bench scale experiments and conflicts have been noted. For these reasons it was decided to establish a pilot plant study to determine the extent the activated sludge process can tolerate metallic wastes, the ex-

tent of removal of metals by the process and what modifications in the process appear desirable. Chromium was selected as the initial subject of study. The pilot plant was designed for a feed rate of 147 gpd, with a primary settling period of 2.3 hrs., an aeration time of 5 hrs., and final settling period of 1.5 hrs. Diffused air aeration was employed. Digestion of sludge was accomplished in five-gallon carboys with water displacement gas collectors. Potassium chromate was fed in the influent in varying controlled concentrations, continuously and as slugs. The results indicated that, short of massive slug dosages, chromate alone is unlikely to harm the operation of a treatment plant. Concentrations of 0.5 mg/L were almost completely removed. While nitrification was impeded for short periods, it was still evident at a concentration level of 50 mg/L. There was a tendency toward build-up of chromium in the activated sludge solids, attaining 18.4 percent on a



Courtesy Journal of the WPC Federation

● **DIAGRAM** of hypothetical operation of deep well disposal of radioactive wastes.

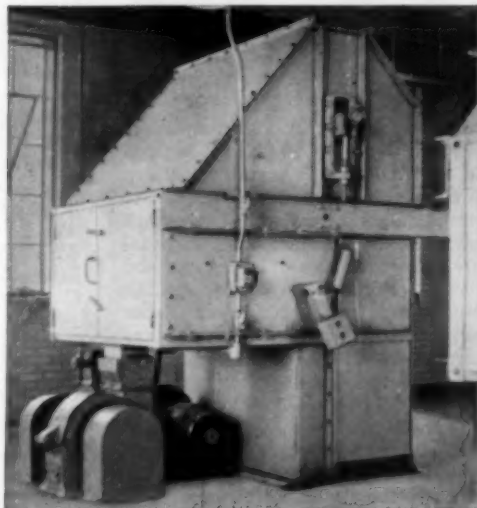
# WHICH SCREEN

## *is best for your job?*

LINK-BELT builds a complete line for efficient removal of solids

### COARSE?

Link-Belt coarse screens, commonly known as bar screens or racks, are preferred in water, sewage and industrial waste treatment plants where the water contains a considerable volume of large solids that might damage or clog subsequent equipment. They consist of a series of parallel bars in the flow channel—either vertical or inclined.



**THRU-CLEAN BAR SCREENS.** Automatic, chain operated rakes clean from down-stream side . . . eliminate jamming by debris. Vertical or inclined bars.



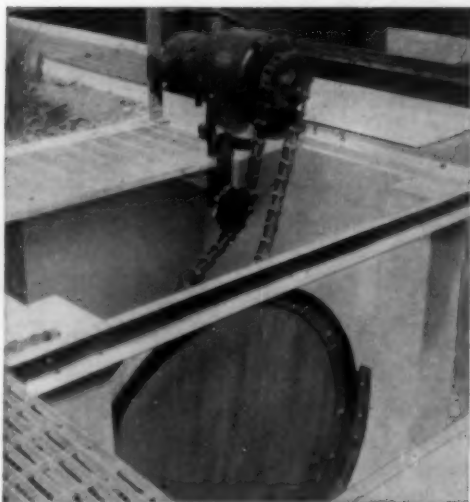
**STRAIGHTLINE BAR SCREENS.** Automatic, jam-proof, cable-operated rake cleans from up-stream side, assures clean, positive screenings removal.



**TRITON SCREENS.** Combined screen and grit chamber saves smaller plants the cost of separate units to remove large solids and grit.

### FINE?

Link-Belt fine screens provide for efficient removal of small solids. They protect subsequent equipment, prevent pollution of streams and often recover valuable products. These screens use a relatively fine mesh cloth making them applicable to water intakes, industrial waste treatment and industrial solids recovery.



**REVOLVING DISC SCREENS.** For applications similar to rotary drum screens, but where volume is less. Easily installed.



**ROTARY DRUM SCREENS.** Effectively remove fine solids from large volumes of water. For fixed water level installations.

**LIQUID VIBRATING SCREEN.** For thorough removal and dewatering of fine solids with minimum blinding of screen cloth.



Efficient water and waste treatment begins with a Link-Belt screen. This broad line is your assurance of an impartial recommendation based on the specific nature of your waste. For more data, contact your nearest Link-Belt office or write for Screening Equipment Book 2587.

# LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. Sanitary Engineering Regional Offices—Colmar, Pa., Chicago 9, Kansas City 8, Mo., San Francisco 24. Sales Offices in All Principal Cities. Export Office, New York 7. Representatives Throughout the World. 18,910



dry solids basis for the period of the study. The digester operated well with as much as 3.5 percent chromium in the solids.

"Effects of Chromium on the Activated Sludge Process." By W. Allan Moore, G. N. McDermott, Mildred A. Post, J. W. Mandia and M. B. Ettinger, Robert A. Taft Sanitary Engineering Center. 1959 *Proceedings of the Oklahoma Water, Sewage and Industrial Wastes Association and Journal WPCF*, January, 1961.

### Metal-bearing Acid Wastes

The Titan Metal Mfg. Co., a manufacturer of copper-base alloy products, using data developed from pilot plant studies, constructed waste treatment facilities at its main plant in Bellefonte, Pa. in 1958. The wastes contain excessive quantities of copper, chromium, zinc and free acidity. The concentrated acid wastes containing chromium are reduced by sulfur dioxide. The effluent is mixed with rinse waste waters in an equalization tank and the resulting mixture is neutralized with lime slurry. After clarification the waste is discharged into a stream. Sludge is transported by tank truck to lagoons. Operating at about half the

design capacity during the first six months of 1959, the plant treated 213,000 gallons of concentrated acid wastes and 37 million gallons of rinse waters. The present cost of treatment is approximately \$0.48 per 1,000 gallons.

"Titan Treats Its Metal Wastes." By W. M. Rumberger, Chief Chemist, Titan Metal Manufacturing Co. *Wastes Engineering*, January, 1961.

### Simplified Ozone Monitoring

In attempting to determine levels of ozone contamination in the Riverside County (Calif.) Air Pollution Control District, it was decided that a simple instrument was needed to assure determination of average values with a minimum of expense and interpretative effort. A method was developed based on the concept that an actual quantitative linear relationship exists between the extent of crack depth in a strip of rubber and the degree of exposure of the strip to ozone. The "apparatus" used was a tin can in which a rubber strip was suspended and elongated by a lead weight. After exposure, the depths of the cracks in the strip were measured under a microscope. By using strips prepared from a standardized rubber

formula and lead weights of definite value it was possible to develop a calibration curve for correlation of rubber cracking with the daily average ozone concentration. Studies showed that the air flow and temperature were not critical in their effect on results with the sampler and that the method was not subject to differences in interpretative ability of technicians. Comparison of the results obtained with those available from automatic instrumentation indicated that the simple apparatus is a good routine monitoring device and suitable for locating spots where more sophisticated instrumentation is needed.

"A Simplified Method for Determining Ozone Levels in Community Air Pollution Surveys." By Theodore Vega and C. J. Seymour, Riverside County Air Pollution Control District, Riverside, Calif. *Journal of the Air Pollution Control Association*, January, 1961.

### Radioactive Waste Baseline

In order to evaluate the impact of future discharges of radioactive waste, the Texas State Department of Health in cooperation with the University of Texas, a background survey was initiated using 117 sam-



\*KLEAN-KOTE IS A TRADE-MARK, U. S. PATENT APPLIED FOR. SILVER-GRAY BAND REG. U. S. PAT. OFF.

## Over 450 million feet in use coast to coast!

The test of time has proved the high quality of Orangeburg Root-Proof Pipe and Fittings for house sewer lines, downspout run-offs and other underground, non-pressure uses.

Orangeburg's Taperweld Joints seal root-proof and watertight. No leakage, no infiltration. And because it's made of a strong, tough non-metallic material, Orangeburg does not rust. Alternate freezing and thawing... acids and alkalis do not affect it.

All these qualities plus speed, ease and economy of installation have gained for Orangeburg a growing acceptance among leading ap-

proving authorities, architects, engineers, builders and plumbers. Over 450 million feet are in service from Maine to California.

And now, only Orangeburg has exclusive new *klean-kote* protective coating for cleaner, safer handling. The Silver Band identifies *klean-kote* Orangeburg: Root-Proof Pipe for sewer lines; Perforated Pipe for foundation drains, septic tank disposal fields. Orangeburg exceeds requirements Federal Spec. SS-P-356 and Commercial Standard C5 116-54.

\*KLEAN-KOTE IS A TRADE-MARK, U. S. PATENT APPLIED FOR. SILVER-GRAY BAND REG. U. S. PAT. OFF.

**klean-kote® ORANGEBURG®**  
Root-Proof and Perforated Pipe **FLINTKOTE®**

Orangeburg Manufacturing Co., Orangeburg, New York, Division of The Flintkote Company, Manufacturer of America's Broadest Line of Building Products

## How to increase aeration capacity without adding new tankage

Here is the new activated sludge system at York, Pa. Sewer Authority. Plant capacity is higher than ever before, yet not a cent has been spent for new basins.

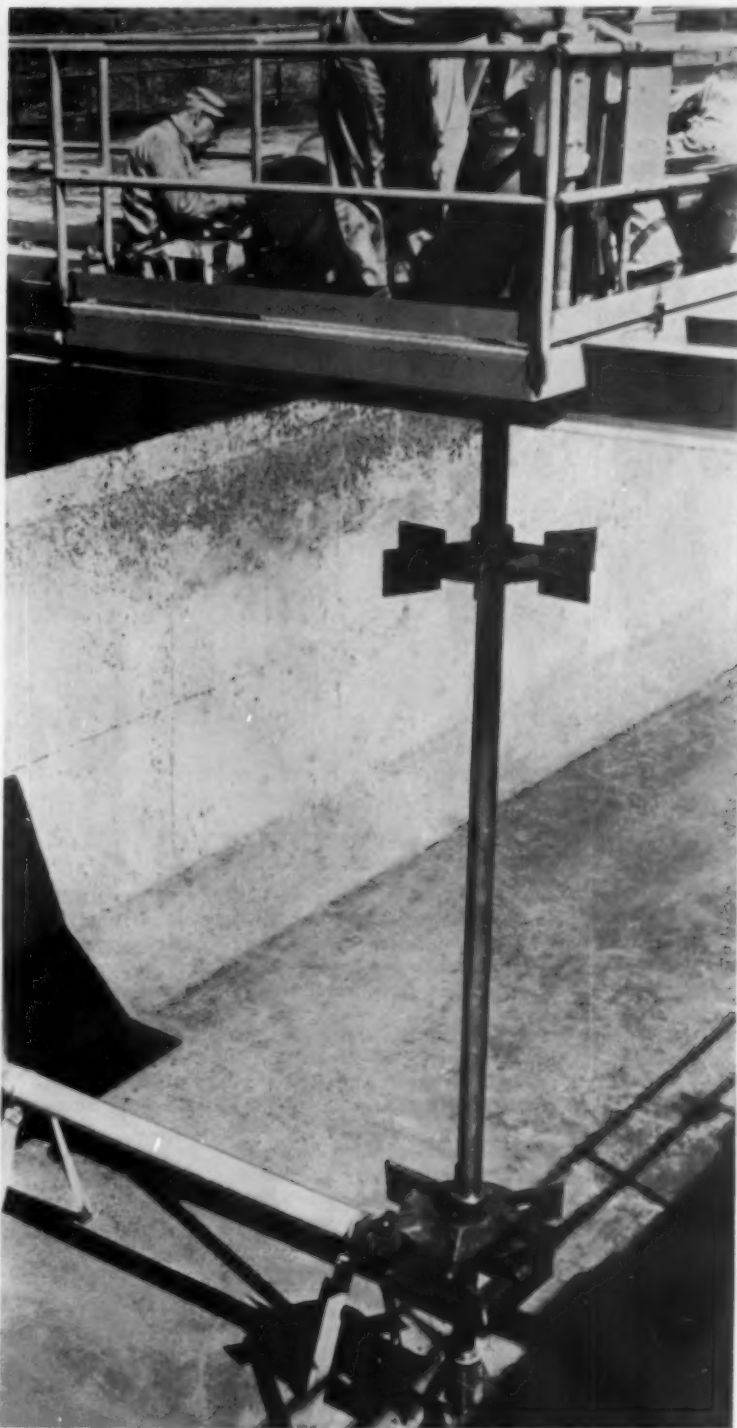
Four Permutit® Permaerators make up the heart of the system. The unit you see being installed is capable of transferring 115 lb. of oxygen per hour with a compressed air flow of only 420 cfm.

High efficiencies of this type are possible by utilizing atmospheric air entrained by the upper turbine of the Permaerator. In addition, the upper turbine redisperses compressed air released from a sparge ring beneath the lower turbine.

Albright & Friel, the consulting engineers, recommended Permutit Permaerators because of their high efficiency, rugged construction, and low initial cost. By the installation of four Permaerators, the system's ability to handle higher hydraulic and biological loadings was significantly increased. Since Permaerators are adaptable to old as well as new basins, this increase in treatment capacity was achieved without construction of any additional tankage.

What York has done, you too can accomplish. If you need to increase the capacity of your activated sludge plant with a minimum of capital expenditure, consider the Permutit Permaerator. For further information, write for Bulletin 4619. Permutit Division, Dept. PW-31, 50 W. 44th Street, New York 36, N. Y.

\*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.



Twin-turbined unit being installed here is one of four Permutit Permaerators now in use at York, Pa.—one in each of two aeration tanks, and two in the return sludge stabilization tank.



**PFAUDLER PERMUTIT INC.**  
Specialists in FLUIDICS... the science of fluid processes

pling stations involving all of the major waterways of the state. Samples were collected monthly and analyzed for gross alpha and beta activity. Some of the streams flow through geologic formations high in radioactivity. These streams showed measurably higher levels of radioactivity than others, with the activity concentrated in the suspended solids fractions. It was also noted that the concentration of radioactive materials increased during periods of high flows, possibly the cumulative effect of fallout from weapons testing, the heavy rains washing radioactive material ac-

cumulated on the ground surface into the rivers. The background studies indicate that none of the Texas streams has been polluted by industrial atomic energy sources. There are four nuclear reactors being used in research and two others to be placed in operation soon. There is a possibility that a uranium ore processing mill will be established in Karnes County, which will produce a serious problem from the standpoints of nearby population density and available waterways. Texas is fourth among the states in the volume of radioisotopes distributed by the Atomic Energy

Commission for medical, industrial and research application. While this is an unlikely source of stream contaminants, close surveillance might be required in the future.

"Texas Prepares to Evaluate Water Pollution." By H. E. Bevis, Texas State Department of Health. PUBLIC WORKS, February, 1961.

### Incinerator Dust Separators

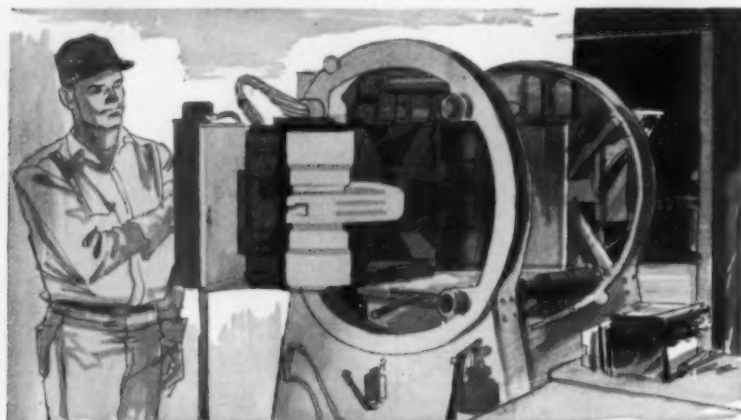
While non-mechanical methods of dust collection at refuse disposal works have reduced complaints it is doubtful if they will consistently meet modern standards, such as those prompted by the Clean Air Act in Great Britain. Of mechanical methods, cyclone separators appear most suitable. The Howden Multi-vortex collector uses an induced draft fan, centrifugal primary and secondary collectors and grit settling tanks. A suitable temperature is maintained by thermostatically controlled hydraulic dampers to admit cold air. The Schneible dust collector consists of a cylindrical tower containing a number of impingement stages, each comprising a horizontal disc from which curved vanes or baffles are suspended. Dirty gas enters the bottom with a swirling motion, and water is admitted above the top impingement stage. A fan is required to pull the gases through. The dust laden liquid effluent is directed to a settling tank. The wet collectors are currently being considered and have one benefit over multi-cellular in that they are probably easier to install in existing works.

"Dust Arresting Plant for Refuse Disposal Works." By P. D. Fairlie, Director of Cleaning, Glasgow. Public Cleansing, (Edinburgh, Scotland), December, 1960.

### Slow Sand Water Filters at Hartford

The Hartford, Conn., Metropolitan Water District uses for treatment a fountain type aerator and slow sand filtration. There are 16 beds of ½ acre area and 6 beds of ¾ acre, four of which have just been completed. These were not used last year when 15,376.8 million gallons of water were filtered at a cost of \$10.97 per mg. To keep the filters in efficient operating condition required 125 washings and 16 harrowings during the year, each of the 18 beds in service being worked on from five to 16 times. The season's work involved removing, washing and replacing about 7,700 cu. yds. of sand.

PUBLIC WORKS for March, 1961



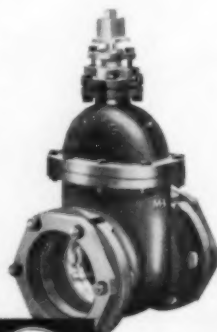
## after 34 YEARS

M & H is proud to be recognized as a true symbol of America's famous industrial revolution which has been in progress for some 50 years. The Company's growth is a typical success story of American ingenuity, engineering talent, manufacturing skills, labor-management team work, and mechanization.

With 40 employees and second-hand equipment, M & H started business in 1926 at the height of American industrial development. Later the product was redesigned and modernized, and the plant completely mechanized. Since that time modernization has been almost continuous. Recent years have seen installation of automatic core-sand handling, automatic core-making machines, automatic foundry equipment, new and enlarged machine shop, new two-story office building, and many other improvements.

M & H valves, hydrants and associated products today are in use throughout the United States, Canada, and in many foreign countries. Water works men, engineers and industrial operators recognize the enviable reputation of M & H products for being made from highest quality material, rugged in design, dependable and efficient service.

(No. 10 of a Series)



**M & H VALVE**  
AND FITTINGS COMPANY  
ANNISTON, ALABAMA





# New

## Oxigritter

*Primary Sewage  
Treatment Unit*



### Combines Grit Removal...

### Pre-Aeration... Clarification

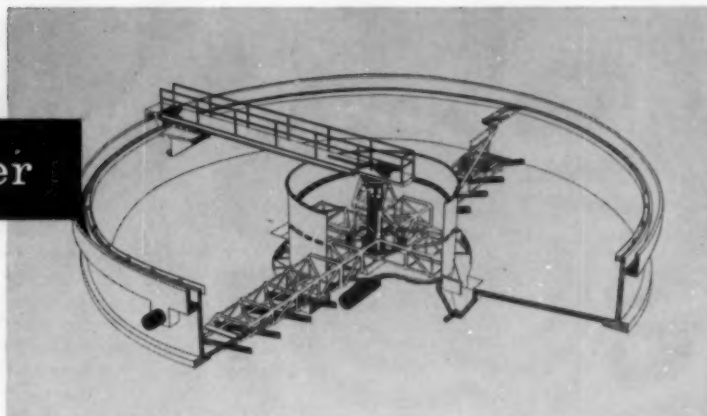
An important new Eimco-Process development for sewage treatment now makes it possible for many treatment plants to remove grit from sewage and get improved clarification at lower costs.

Multi-purpose Oxigritter treatment units provide grit separation, pre-aeration and clarification all in one double compartment tank. Its use results in a much simplified flowsheet, savings in space, and minimum investment in structures and equipment.

An Oxigritter is essentially a primary clarifier having an inner pre-aeration compartment in which grit separations 65 to 200 mesh are made before organics pass to the primary sedimentation compartment.

Because grit separation is controlled by aeration, the sewage flow is also pre-aerated and freshened in the center compartment. If intermediate treatment is desired for periodic or seasonal operation, the addition of chemicals for solids flocculation provides 75 to 85 percent suspended solids removal with corresponding BOD reductions. When trickling filters are used the reduced organic loading results in savings in construction costs.

The Eimco-Process representative in your area can tell you other interesting facts about Oxigritter units for low-cost sewage treatment. Ask him, too, for new Oxigritter Bulletin SM-1016. Or, you may get your copy by writing direct to Eimco's Process Engineers Division.



**THE EIMCO CORPORATION**

*Salt Lake City, Utah*



B-706

*Process Engineers Division*

*420 Peninsular Avenue, San Mateo, Calif.*



For additional grit washing and dewatering, the Eimco-Process Cycle Grit Washer can be used with Oxigritter units for almost complete removal of putrescibles and objectionable light materials. Use of Cycle Grit Washer is especially desirable when grit separations of 100 to 200 mesh are made in the Oxigritter.

Oxigritter and Cycle are trademarks of The Eimco Corporation

# EXPERIENCE WITH THE DALLAS INDUSTRIAL WASTE ORDINANCE

**W. D. BENTLEY**

Industrial Waste Engineer,  
Dallas City Water Works

*Presented at the 1960 Texas Water and Sewage Works Association Short School, Texas A & M College.*

**T**HE DALLAS industrial waste ordinance, No. 7930, observed its first anniversary in January, 1960. The experiences gained permit us to take a look at the results achieved and to attempt to evaluate the benefits derived to date.

As a matter of fact, the first year's operations were preceded by four years of hard work and a great deal of study and preparation. In 1955, the Water Superintendent, Henry J. Graeser, and members of his staff recognized that the City of Dallas was experiencing a rapid industrial growth with the installation of a large number of industrial plants with substantial liquid waste discharges, without an ordinance on the books to provide either quality control or equitable service charges for the sewerage service rendered. An old ordinance was in effect, but a modern and explicit set of regulations was needed to establish realistic limits on concentrations of harmful substances and to enable the water department to charge the industries in proportion to the costs of collecting and treating their waste.

The first step in developing the new industrial waste ordinance was to conduct a comprehensive survey of all existing industries. All industries coming into the community were advised that an ordinance was in the making and that they should provide facilities for such pretreatment of their waste as might be required. With the cooperation of a representative group of the principal industries concerned, a comprehensive sampling program was instituted. The city employed an experienced and well qualified industrial waste engineer, E. J. Axe, and provided the necessary equipment and helpers to gather samples and check volumes of wastes discharged. Analyses of industrial wastes samples were run in the laboratory of the sewage treatment division which added the necessary equipment and personnel to handle the additional

volume and the more complex determinations required.

After two years, sufficient data had been compiled to develop some very striking conclusions. For instance, it was found that a group of 20 industries in the city was contributing 30 percent of the total solids received at the sewage treatment plant and that the wastes of one industry had an organic loading population equivalent of 90,000; and paying only about \$500 per month.

Studies were continued through 1958 to determine the overall effect of the increasing load of industrial wastes on the operation of the city sewage treatment plants. From these studies, data were developed to prepare charts for presenting the problem to the Chamber of Commerce which was interested in attracting new industries into the area. The same information was presented to the city council to demonstrate the seriousness of the problem and the need for a new and comprehensive ordinance. These charts demonstrated very forcibly that industrial wastes were responsible for a continuing increase in the strength of sewage reaching the treatment plants. By August, 1958, the suspended solids concentration of the raw sewage was running 62.4 percent above that of normal sewage and the BOD was 54.5 percent above the normal value.

In the presence of such clear-cut evidence of the responsibility of industrial wastes for the overloading of the plants and for increased costs of operation, there was little or no opposition to the enactment of the industrial wastes ordinance. The fact that the Dallas City Water Department is operated as a public utility, without subsidy from tax revenues, has facilitated convincing the industries responsible for the increased pollutional loadings that it is only fair and equitable that they should bear a greater share of the costs of sewage treatment.

## **Provisions of the Ordinance**

The Dallas industrial wastes ordinance was designed to accomplish two definite purposes: 1) To cover specific wastes which could not be discharged into the system and to establish limits for corrosive and toxic substances; and 2) to limit the concentration of grease, suspended

solids, and BOD to those of "normal" sewage, as defined by the ordinance. The list of prohibited substances and the limits of concentrations of corrosive and toxic substances were based largely on a study of industrial wastes ordinances adopted by other cities. The concentrations of 325 ppm each for suspended solids and BOD, adopted as the criteria for "normal" sewage were based on the actual average strength of the raw sewage received at the main city treatment plants (Old Dallas and White Rock) during the 1956-57 fiscal year.

The ordinance includes a section providing for access to private properties for the purpose of inspection and sampling and a section making violations of the ordinance a misdemeanor, punishable by a fine. Other provisions require the industrial customers to secure permits for the admission of industrial wastes to the sewer system and require the installation and maintenance or a suitable inspection chamber or manhole for inspection and sampling.

The industrial waste ordinance retains the control of prohibited substances, or excessive concentration of corrosive or toxic materials, provided by the old ordinance, under which the Water Superintendent can, after written notice giving a reasonable time limit for satisfactory correction, disconnect the violator from sanitary sewer and/or water service. This provision was invoked in one instance soon after adoption of the ordinance, but under present policy it will be used only as a last resort in instances where an industrial customer has been given ample time to institute corrective measures. During the first year of enforcement of the ordinance, it has been found that the engravers are making substantial progress in the neutralization of acid wastes, but that much remains to be done, particularly with some of the metal plating industries, to secure adequate control of the discharges of chromium, copper, zinc, cadmium, nickel and cyanides to limit the metals concentrations to not more than 3 ppm and cyanide to a maximum of 2 ppm.

At the time of securing a permit for the discharge of industrial wastes to the sewer system, the customer agrees to pretreat or to elimi-



# a new program

## for progressive improvement of secondary roads

This hard, firm unpaved road will eventually serve as a base for paving. Columbia Calcium Chloride keeps its surface stable, pays its way with reduced aggregate and blading costs.

**QUESTION:** How can you establish a stable, dustless surface for roads that merit it, when your yearly budget allows for paving on only a small portion of these roads?

**ANSWER:** A balanced program for roads utilizing the proved benefits and economy of Columbia Calcium Chloride for *Stage Construction and Improved Maintenance Standards*.

**STAGE CONSTRUCTION PROGRAM** consists of:

1. Improving width, alignment and drainage.
2. Placing the initial course of Columbia Calcium Chloride stabilized aggregate wearing surface. Columbia Calcium Chloride is used in this surface to hold fines moist and tie down stone. In some cases, traffic may use this surface for several years.
3. Adding the compact, dense-graded aggregate base course in sufficient thickness and gradation to support projected traffic. To insure uniform moisture for material stability, Columbia Calcium Chloride should be mixed with the base material or applied to the surface.
4. Paving as funds become available *in the future*. Usually little additional base work need be done. The base is stable with good grade which helps insure a successful paving job.

**IMPROVED MAINTENANCE STANDARDS** include:

1. The elimination of dust as a hazard, waste and inconvenience.
2. The ability to keep more roads well graded.
3. Future paved surface will be better because of more stable base. The use of Columbia Calcium Chloride is the soundest procedure for meeting the basic needs of a progressive improvement program.

Get complete information about a balanced program of secondary road improvement and how Columbia Calcium Chloride benefits both the road official and the road user. Write today for your free copy of this illustrated bulletin.



columbia | southern  
chemicals

CHEMICAL DIVISION

PITTSBURGH PLATE GLASS COMPANY

ONE GATEWAY CENTER PITTSBURGH 22, PENNSYLVANIA

DISTRICT OFFICES: Boston • Charlotte • Chicago • Cincinnati • Cleveland  
Dallas • Houston • Minneapolis • New Orleans • New York • Philadelphia  
Pittsburgh • San Francisco • St. Louis • IN CANADA: Standard Chemical Limited

Columbia Calcium Chloride  
One Gateway Center  
Pittsburgh 22, Pa.  
Please send me a copy of "A Program for PROGRESSIVE IMPROVEMENT of Secondary Roads."



Name \_\_\_\_\_  
Title \_\_\_\_\_  
Organization \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



# ATTENTION LANDSCAPE ARCHITECTS **NEW** CHEMICAL CONCENTRATE ENDS REST AREA PRIVY ODORS!



## Get Complete Proven Success with **SANI-SEPTIC** CONCENTRATE FORMULA—500—I. R. B.

Revolutionary new Sani-Septic Concentrate is a complete new approach to the problem of rest area odor control. The result of extensive research and development, Sani-Septic Concentrate destroys the bacteria that are the source of privy odors. Unlike other products, Sani-Septic is not a perfume or odor "cover-up." It leaves no odor of its own. Sani-Septic is a liquid that is diluted with water and poured into the privy vault. It destroys present odors and future odors. It is economical to use and is unconditionally guaranteed to provide the sanitation required. Test installations in the State of Ohio rest areas and roadside parks have proven the unique effectiveness of Sani-Septic Sanitation.

### Why Sani-Septic Destroys Odor

Sani-Septic Concentrate completely ends odor where others fail because it controls the growth of the microorganisms that produce sulphides with their strong unpleasant odors. In addition it prevents the growth of fungi that speeds decomposition of waste materials and resulting offensive odors.

Send for complete information.

## WERLEY CHEMICAL & SUPPLY CO.

1505 Broadway  
Cleveland 15, Ohio

nate all prohibited wastes and declares his intent either to pretreat or not, to eliminate or to reduce the concentrations of suspended solids and/or BOD in excess of those of "normal" sewage. The customer further agrees, whether he elects to pretreat or not, that if a representative composite sample shows the plant effluent to have concentrations of suspended solids and/or BOD in excess of 325 ppm, he will pay a surcharge based on a rate of \$0.063 per million gallons of flow per ppm of suspended solids and/or BOD in excess of "normal." This established surcharge rate of \$0.063 per million gallons per ppm is based on the 1956-57 actual unit costs for removal of suspended solids and BOD, including amortization of treatment plant costs.

After a surcharge rate has been established for an industrial customer, it is routinely reviewed in about six months by analyzing a 48-hour composite sample of its effluent. Occasional grab samples are taken to police the surcharge agreement. The industry may request a review after a change in plant facilities or processes, but may be required to pay the cost of such special sampling and analysis. The industries are encouraged to have independent laboratory checks of duplicates of our samples, but the ordinance provides that all determinations shall be made in accordance with "Standard Methods" and that the results determined by the City's sewage treatment division laboratory are "official" for enforcement of the ordinance.

### First Year Results

During 1959, the industrial wastes section has made the transition from investigation and research to enforcement and education. At the beginning of the year, the personnel of the section consisted of an industrial waste inspector and two samplers, equipped one automatic sampling pump and a station wagon. The section now has an industrial waste engineer, a chemical engineer, two industrial waste inspectors and six samplers, with three automatic sampling pumps and three station wagons. In the division laboratory, two chemists have the primary responsibility of analysis of industrial wastes samples.

In the first year, field surveys and composite samplings were accomplished for a total of 188 industrial plants, which included the major representatives of the following categories: 13 automotive and air-

motive shops; 11 beverage bottlers; 13 dairies and ice cream manufacturers; 31 food processors; 35 commercial and industrial laundries; 20 meat and poultry packers and processors; 35 metal plating and engraving plants; 17 miscellaneous inorganic processing plants, and 13 plants processing organics and fibers. Additional plants and installations are being checked and sampled at a rate of 10 or 12 per month. While spot checks indicate that many hotels, restaurants, cafeterias, department stores and hospitals are technically subject to surcharge for sewage strengths somewhat in excess of normal, sampling difficulties and lack of personnel and equipment have so far precluded these establishments being added to the list required to execute surcharge service contracts.

To the question "but are you doing any good toward reducing the loads on the sewage treatment plants?" the answer is yes, but the exact extent of the improvement is still subject to statistical analysis. Some results are apparent—we no longer receive at the sewage plant such obvious evidences of gross pollution as whole animal paunches, beans by the cubic yard, masses of shredded paper stock and slugs of red dye or yellow chromates. Also, it has been several months since either of the main plants has received any appreciable quantity of free floating petroleum oil or grease. The sanitary sewer maintenance division has commented, unofficially, that the stoppages caused by grease collection in lateral sewers have decreased appreciably during the past year, and we believe that a stepped up program of inspection of grease traps by industrial waste personnel will further improve this effect.

We can cite some specific improvements in the effluents from a few of the industries which are heavy pollution contributors, from the standpoints of both volume and concentration. A paper mill which contributes a total flow of nearly 50 million gallons of waste per month has installed a filter on the production unit which was producing the worst waste, and has reduced the suspended solids in the flow from that unit by approximately 39 percent. Installation of this filter and of recirculating pumps has also reduced the total contribution of suspended solids by about 30 percent and the plant is now recovering valuable paper-stock fiber which formerly was lost into the sewer.

(Continued on page 193)

## ESSICK VIBRATING COMPACTORS



ESSICK VR-28-W PATCHING ASPHALT IN GARDEN GROVE, CALIF.

### "MAINTENANCE PRODUCTION TRIPLED... ... COSTS DECREASED 80%"

**SEWARD H. DART, STREET MAINTENANCE SUPERINTENDENT—SHOWN WATCHING HIS 28" ESSICK VIBRATING COMPACTOR IN ACTION—STATES:**

"Irrigation water tracked into the intersections and gutter aprons in Garden Grove, constantly eroded the asphalt and made maintenance a full time problem. As a result, our gutter and intersection patching required frequent reworking, and our costs were high.

"After a demonstration of the 28" Essick Vibrating Compactor, we knew we had found the answer. It was self-propelled, hooked on the tail gate of a dump truck, and produced compaction equivalent to an 8 ton roller on asphalt. Its high frequency vibration compacts an asphalt patch that is completely dense—that can be opened immediately to traffic without any marking or damage to the asphalt.

"Now with our patching unit consisting of the 1½ ton dump truck, an Essick 120 gallon Truck Mounted Emulsion Unit, a propane torch, and the Essick VR-28-W Vibrating Compactor, the patch life has been tremendously extended, our maintenance production has tripled, and our costs have decreased 80%.

"The Essick VR-28 really solved the patch problem for us."

#### SELF PROPELLED — MANEUVERABLE — PORTABLE

Essick High Frequency Vibrating Compactors are constantly exceeding the densities and specifications performed by other compaction methods, while creating new standards of compaction for all types of fills, sub base, base materials, and asphalt.

**CALL YOUR ESSICK DEALER FOR A DEMONSTRATION**



9 Models of Vibrating Compactors from 1½ to 22 Tons

Also 14 models of Tandem Rollers from ½ to 14 Tons

### ESSICK MANUFACTURING COMPANY

1950 Santa Fe Avenue  
Los Angeles 21, California

850 Woodruff Lane  
Elizabeth, New Jersey

Affiliated with THE T. L. SMITH COMPANY, Milwaukee, Wisconsin

## Quality pays in a TRENCHER

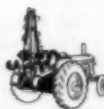


## AUBURN

IS BETTER BUILT TO GIVE YOU  
MORE PERFORMANCE

Every part of your Auburn trencher is precision designed and manufactured. You can depend on Auburn to deliver when others fail. The Auburn trencher is rugged and will dig up to 800 ft. per hour—trenching 6" to 14" wide and down to 6' deep—featuring a variable hydraulic drive that automatically adjusts speed to changing soil conditions.

Time and performance are the basic ingredients of a profitable trenching operation. The Auburn Quality Trencher gives you both on every job.



#### AUBURN GEAR-DRAULIC

Tractor-mounted trenchers are available for M-F Work Bulls, IH Utility, John Deere Crowler and Wheel Industrial, and Ford Tractors.



#### Jeep-A-Trench GEAR-DRAULIC

the original Jeep-mounted trencher, and only trencher approved by Willys Motors. Available at Jeep Dealers.

### AUBURN MACHINE WORKS, INC.

2045 South J Street, Auburn, Nebraska, U. S. A.  
Phone BRidge 4-3141

Please send complete information and name of nearest dealer.

Name \_\_\_\_\_

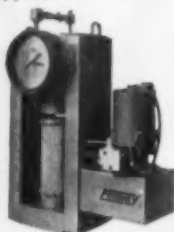
Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

## FORNEY CONCRETE TESTERS

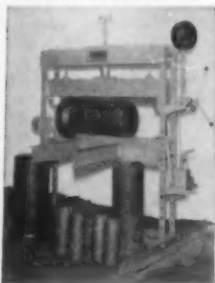
meet the exacting requirements of the construction industry's concrete testing applications.

Forney engineers are proven specialists in the concrete testing equipment field. For eleven years they have furnished the industry with quality testing equipment, accessories and supplies.



### MODEL FT-30 HEAVY-DUTY PORTABLE CONCRETE TESTER

Latest addition to a complete line of portables, the FT-30 brings laboratory performance right to the job site. Self-contained power unit eliminates cumbersome hose and manual pumps. Loading speed is completely variable for accurate conformance to current ASTM standards.



### MODEL PT-15 TILE TESTING MACHINE

Has 14,000-lb. capacity and is designed for testing clay and concrete drain and sewer tile up to 24" I.D. and 48" lengths. Equipped with two pumps for fast loading and slow application of critical load. Conforms to current ASTM standards.

**ALL FORNEY EQUIPMENT UN-  
CONDITIONALLY GUARANTEED**

**KNOWN THE WORLD OVER**

**FORNEY'S, INC.**

Tester Division  
P. O. Box 310  
New Castle, Pa., U. S. A.  
Phone OLiver 2-6611  
Cable: Forney's, New Castle

## Municipal Power

### Sources of Additional Power Supply

**BRUCE J. ENNIS**

Associate,

Burns & McDonnell Engineering Co.,  
Kansas City, Missouri

**F**ROM time to time, as loads grow on the typical municipal electric system, it becomes necessary to add generating equipment in the power plant to produce the additional energy required to serve new consumers and increased demands of existing consumers. For reasons of economy, the construction cost for the installation of such equipment must be kept as low as is consistent with adequate and dependable service. Similarly, it is essential that efficient generating units be installed to permit the lowest production cost per kilowatt hour for the amount of investment required.

All other factors being equal, the best unit for a given plant is that unit for which the summation of annual fixed charges (based on the installation investment required) and production expenses (based on the cost of fuel, labor, maintenance, etc.) is at a minimum for the additional plant capacity required.

For the large sized utility, base load carrying generating units are usually of the multi-kilowatt steam turbine generator type with its associated boiler and auxiliaries. Recent developments indicate the feasibility, as well, of a combined cycle type of plant in which a gas turbine generator is coupled with a steam generating unit to utilize the otherwise waste-heat in the exhaust of the gas turbine as partial heat input to the steam boiler.

For the small and medium sized plant, base loaded generating units are generally of the diesel or dual-fuel internal combustion engine type, or of the moderately sized steam turbine generator type. In such a plant, the selection of the type of generating unit that should be installed by a given utility system will depend on the rate of interest and depreciation to be

charged against the investment required, the cost of fuel, labor and maintenance necessary to operate the unit and keep it in efficient, serviceable condition, and related expenses.

Dual fuel engine generator units are available in small to medium sizes, whereas steam turbine generating units range from moderate size to very large capacities. For a given set of conditions, the logical selection of the type of generating unit which would provide the most economical plant addition depends on the inter-relation of these conditions and the expenses corresponding to the type of unit selected. To illustrate this point, purely as an example and not as a basic guide, a study illustrated in Fig. 1 was made assuming various sizes of generating units operating at 50 percent load factor and using very general data for fuel, labor, maintenance, fixed charges, and other expenses.

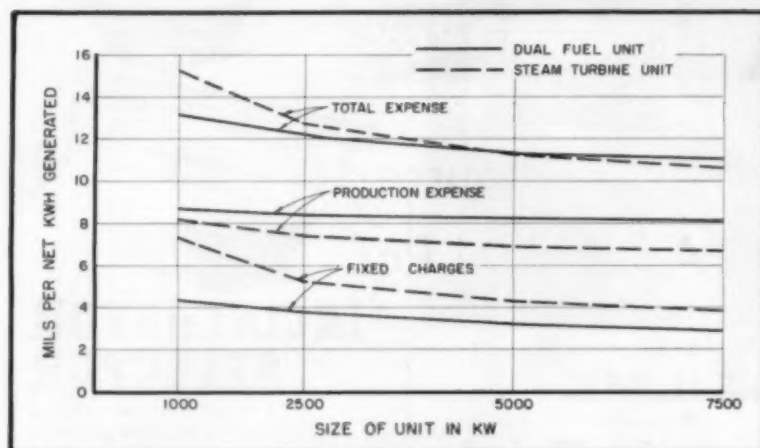
In this particular example, the total expense per net KWH generated would indicate that either a dual fuel or a steam turbine unit could be used if system improvement required 5000 KW of additional generating capacity. Plant additions smaller than this would favor the dual fuel unit, and plant capacity additions greater than 5000 KW would indicate the desirability for installation of a steam turbine generator. Obviously, known data for a specific system could raise or lower the optimum break point above or below the 5000 KW capacity determined by this example.

#### Interconnection Possibilities

In any plant expansion program, the inherent advantages of possible inter-connection with a neighboring utility system should not be overlooked. Such advantages include the following:

1. During emergency periods in either plant, power can be supplied by the other station.
2. To insure continuity of service,





● FIGURE 1. Hypothetical example illustrates the way an evaluation can be made of the fixed charges and production expenses for two types of generating equipment.

it is necessary for each plant to provide sufficient reserve capacity to meet maximum system demands with the largest single unit in reserve. By "pooling" the generating capacity of

the two or more plants through tie-line interconnection, the necessary reserve capacity will be reduced, resulting in a saving in fixed charges on expensive generating equipment.

3. The newest, and most efficient generating units in either plant can be base loaded to generate the bulk of combined system energy requirements at lowest possible cost. The older and less efficient units would be used during the peak load periods and for reserve capacity during emergencies.

As an example of the economic advantages of pooling generating capacity through system interconnection, a study has been made based on average construction cost values for three theoretical utilities. These are detailed in Plans A and B. In the example shown by Plan B, interconnection would permit the three utilities to realize mutual savings in investment of more than one million dollars by pooling reserve capacity in Plant No. 1. By means of a suitable working agreement among the utilities, subsequent generating unit additions could be installed in Plant No. 2 and later, in Plant No. 3 if it becomes necessary.

#### PLAN A—Individual Utilities Without Interconnection

Item	Utility No. 1	Utility No. 2	Utility No. 3	Totals
Assumed Peak Demand in KW	15,500	6,000	7,500	29,000
<b>Generating Capacity in KW:</b>				
Total Capacity Required	23,000	9,500	12,500	45,000
Less Largest Unit				
(Standby Capacity Required)	7,500	3,500	5,000	16,000
Firm Capacity	15,500	6,000	7,500	29,000
Total Investment Required	\$4,600,000	\$1,900,000	\$2,500,000	\$9,000,000

#### PLAN B—Interconnected Utilities with Pooled Standby Capacity

Item	Utility No. 1	Utility No. 2	Utility No. 3	Totals
Assumed Peak Demand in KW	15,500	6,000	7,500	29,000*
<b>Generating Capacity in KW:</b>				
Total Capacity Required	23,000	6,000	7,500	36,500
Less Largest Unit				
(Standby Capacity Required)	7,500	0	0	7,500
Firm Capacity	15,500	6,000	7,500	29,000
<b>69 KV Transmission System:</b>				
Miles of Transmission Line Req'd.	0	20	20	40
Tie Line Transformer Capacity Required in KW	7,500	3,500	5,000	16,000
<b>Investment Required:</b>				
Power Plants	\$4,600,000	\$1,200,000	\$1,500,000	\$7,300,000
Transmission Lines	0	200,000	200,000	400,000
Tie Line Transformers	37,500	17,500	25,000	80,000
Substation Structures & Equipment	40,000	40,000	40,000	120,000
Total Investment Required	\$4,677,500	\$1,457,500	\$1,765,000	\$7,900,000

\*Note: Neglecting diversity of load between utility systems.

# MORE THAN 2000 PRESTRESSED CONCRETE TANKS IN SERVICE



New 660,000 Gallon Stand Pipe  
City of Wadsworth, Ohio.

Consider these features

- Minimum maintenance
- 75% construction cost spent locally
- Owners seldom return to other types
- Longest service life of any tank
- Lowest overall cost to community

Send for Bulletin T-22



## THE PRELOAD COMPANY, INC.

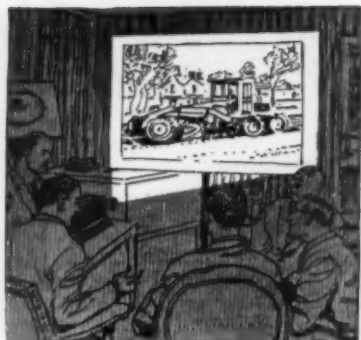
355 Lexington Ave., New York 17, N. Y.  
Tel.: MUrray Hill 7-0488

1216 Hartford Bldg., Dallas, Texas  
Tel.: RIVERSIDE 8-4047

PRELOAD CONCRETE  
STRUCTURES INC.  
837 Old Country Road  
Westbury, L. I., N. Y.  
Tel.: EDGEMOND 3-0808

THE CANADA GUNITE  
COMPANY, LTD.  
125 Myrus Boulevard  
Pte Claire, P. Q., Can.  
Tel.: OXFORD 5-6772

HERRICK IRON WORKS  
28400 Clawiter Road, Hayward, Calif.  
Tel.: LUCERNE 1-4451



## FILMS

### in Brief

Listed below are motion picture films of current interest to engineers, administrators and supervisors in the public works field. The companies providing these films have indicated that the films are available for appropriate use by PUBLIC WORKS readers. Requests for films should be made direct to the company listed with the film.

#### "Hyster High-Speed Compaction."

Outlines development of the compactor and compaction rollers with compaction cost data and requirements of different soils included. (12½ min., color.) Hyster Company, P. O. Box 328, Peoria, Illinois.

"What Is Electricity?" A presentation of fundamental electrical theory demonstrated in animated sequences. (20 min., black and white, sound, 16 mm.) Motion Picture Department, Westinghouse Electrical Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

"Asphalt in Hydraulics." How asphalt is used to pave and protect dams, dikes, canals, reservoirs and jetties. (19 min., color, sound, 16 mm.) The Asphalt Institute, University of Maryland, College Park, Maryland.

"Look to the TS-360." Explains the production, operating and mechanical advantages of the 30 cu. yd. motor scraper. (15 min., color, sound, 16 mm.) Allis-Chalmers Manufacturing Co., Sales Promotion Department, Tractor Group, Box 512, Milwaukee, Wis.

"The Constructors." Educational film offering a realistic introduction to the field of engineering in construction, prepared for guiding qualified students into an engineer-

THE ANSWER  
COMES OUT  
HERE



MORSE  
BOULGER

## INCINERATOR SELECTOR

A handy, pocket-size device, designed by our engineers to make life easier for you. Complicated computations are eliminated. At a glance you see the type and size Morse Boulger Incinerator Unit required for your specific job.

FREE

One of these tremendous time-savers will be sent free upon request. (Extra "Selectors" \$3 each, 4 for \$10).

### MORSE BOULGER



Today's engineering plus more than 70 years experience building incinerators of all types and sizes.

80 FIFTH AVENUE  
NEW YORK 11, N. Y. Dept. 73  
REPRESENTATIVES EVERYWHERE

Member: Incinerator Institute of America  
Air Pollution Control Association

## Principles of SOIL ENGINEERING

By Robert F. Baker

**S**OIL engineering is the practical application of engineering principles to problems involving the use of soil, either in its natural condition, or as a construction material. In this authoritative booklet all phases of soil engineering are treated in simple, easily understandable language. Full information is provided on basic soil properties, classification systems, field and laboratory tests, frost action and compaction. Liberally illustrated and containing many special charts and graphs to assist the engineer in his work.

**O**RDER from Book Department, PUBLIC WORKS, 200 So. Broad St., Ridgewood, N.J. Only \$1.00 per copy.

With Dresser® Style 38 Couplings, sleeves go in fast. Less time is spent in the ditch and water flows again with a minimum of inconvenience. No other pipe joining method can offer the versatility and adaptability of the Dresser Style 38. Any workman can join pipe permanently, tightly and fast...without lengthy training or supervision. No elaborate equipment...the only tool needed is a wrench. Couple joints in tight places too, even under water if the ditch fills. For versatility and adaptability you can't beat Dresser Style 38 Couplings. Available from your Water Works Distributor...call him today.



DRESSER  
INDUSTRIES,  
INC.

OIL • GAS  
CHEMICAL  
ELECTRONIC  
INDUSTRIAL



**SLEEVING-IN IS A BREEZE**

PHOTO TAKEN NEAR KEY WEST, FLORIDA



ing career. (17 min., color, sound, 16 mm.) Public Relations Department, Associated General Contractors of America, Inc., 20th and E Streets, N.W., Washington 6, D. C.

**"Industrial Gases and Shielded Arc Welding."** Features recently developed welding equipment and techniques. (27 min., color, sound, 16 mm.) Local representative of Air Reduction Sales Company.

**"Casting and Erecting Concrete Curtain Walls."** For contractors, engineers and architects interested in the numerous methods used to cast and put in place curtain wall panels. (22 min., color, sound, 16 mm.) Local district office of Portland Cement Association.

**"Centriline Process."** Describes internal pipe lining operations. (18 min., color, sound.) Centriline Corporation, 140 Cedar St., New York 6, N. Y.

**"Littleford Clarkmoore Heater-Planer."** Illustrating the use of the unit in preheating and planing the surface of corrugated or eroded streets. Advertising Manager, Littleford Bros., Inc., 443-457 East Pearl St., Cincinnati 2, Ohio.

## Versatile Equipment for a Small City



● ASPHALT spreader attachment used with the Hough Payloader tractor-shovel.

THE CITY of Linwood, Kans., recently purchased a Model H-50 Payloader tractor-shovel with 5,000 lbs. operating capacity. Along with the regular bucket the City purchased a snow plow, V-blade, Ram sweeper, and Ram asphalt spreader attachments. Only 15 min-

utes are needed to switch from one attachment to another.

The illustration shows the Hough unit with spreader attachments repairing the damage to blacktop streets caused by winter weather. In an 8-hr. day, the Payloader will handle up to 60 tons of material.



CUTS WEEDS • MOWS LAWNS • MULCHES LEAVES

### The rugged ROOF VP MOWER

*Nearest thing to  
power-steering in a  
heavy-duty mower!*



The new Roof Swivel-Glide mower is engineered to handle all heavy duty mowing requirements from heavy weed and brush cutting to spacious lawn areas.

#### COMPARE THE FEATURES . . . WEIGH THE FACTS

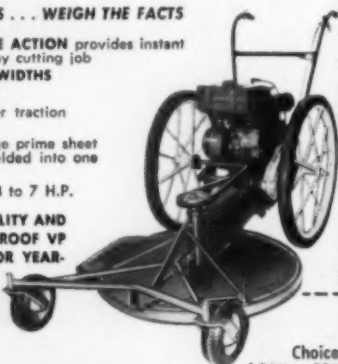
- VARIABLE PITCH BLADE ACTION provides instant blade adjustment for any cutting job
- 26" OR 30" CUTTING WIDTHS
- OIL BATH GEAR DRIVE
- 26" WHEELS for greater traction and maneuverability
- CHASSIS is heavy gauge prime sheet steel reinforced and welded into one rugged unit
- CHOICE OF ENGINES 4 to 7 H.P.

VERSATILITY, MANEUVERABILITY AND RUGGED, LONG LIFE MAKE ROOF VP MOWERS YOUR BEST BET FOR YEAR-ROUND MAINTENANCE

For FREE FACT FOLDER

write:

ROOF MANUFACTURING CO., Pontiac 12, Ill.



Choice  
of 26" or 30"  
Cutting Widths

## McGOWAN

SELF-PRIMING  
CONTRACTOR  
PUMPS

**DELIVERY**  
WHERE IT COUNTS!

NO TROUBLESOME MECHANISMS • HIGH OUTPUT  
LOW MAINTENANCE COST • LOW OPERATING COST

DEPENDABLE McGOWAN PUMPS are available in 23 capacity sizes for regular contractor pumping jobs . . . Hi pressure pumps for flushing and temporary water systems . . . diaphragm pumps for sludge and solids content . . . both light weight and heavy duty designs. Write McGOWAN for complete information or contact your nearest dealer . . . listed under pumps in your phone book.

## McGOWAN PUMPS

DIVISION OF LEYMAN MANUFACTURING CORP.

10946 Kenwood Road, Cincinnati 42, Ohio

# Industrial Waste Ordinance (Continued from page 186)

A meat packing plant with a sewage flow of approximately 10 mg per month, has no pretreatment units other than a single rectangular settling and skimming tank with a mechanical collector system. This plant, by keeping this tank operating consistently, and by generally improving its housekeeping, has reduced its pollution load very substantially. In August, 1958, a 48-hour composite sample showed average ppm concentrations as follows: suspended solids, 4777; BOD, 2407; and grease, 1311. By comparison, a similar sample taken in October, 1959, had average ppm concentrations of suspended solids of 2375; BOD 1969; and grease 594. While this is still a heavy loading, the reductions effected by improvement of plant operations alone resulted in reductions of 50 percent in suspended solids, 18 percent in BOD, and 54 percent in grease discharged to the sewer.

Another meat packing plant having a sewage flow of about 4½ mg per month, has installed a blood dryer and started segregating blood from its waste stream and also has installed 90-mesh shaker screens to screen all of its wastes except stock pen washings. The blood dryer has resulted in by-products recovery valued at approximately \$2000 per month, and the overall strength of the plant effluent has been reduced substantially. In February, 1959, suspended solids were 2571 ppm; BOD was 2293; and grease was 999. After the new units were installed, samples taken in October, 1959, showed suspended solids, 1642 ppm; BOD 1683; and grease 557. These reductions in concentration amounted to approximately 36 percent for suspended solids, 26.5 percent for BOD and 44 percent for grease.

The first packing plant has retained a consulting engineer who has recommended the installation of shaker screens and a trickling filter to effect further reduction in the pollutional load from the plant, the second packer is securing cost estimates for a clarifier and digester, with a mechanical skimmer, to accomplish the same purpose. Laboratory tests on the effluent from the shaker screens indicate that its concentration of suspended solids may be reduced by 45 percent and of BOD by 20 percent by sedimentation for one hour. Of course, the determination of the capital cost plus operational costs of such installations, as compared to the possible

## THE LELY PRECISION FERTILIZER

**DISTRIBUTOR is an outstanding success  
in the United States, Canada and Europe**

TWO TYPES TO CHOOSE FROM: • 3-point hitch machine (as shown)  
• Pull type wheel driven machine

- |                               |   |
|-------------------------------|---|
| ✓ Check these sales features: | ✓ High quality machine. ✓ Spreading width up to 50 ft.<br>✓ High accuracy of fertilizer distribution.<br>✓ Very easy to clean, as hopper can be detached by quick release.<br>✓ Spreading disc and agitator of special design.<br>✓ Big hopper capacity.<br>✓ Spreads any kind of fertilizer and all types of seed. |
|-------------------------------|---|


Factory warehouses in the United States and Canada:

Write for the name of your nearest distributor.

**LELY Ltd.**

P.O. Box 235  
Burlington (Ontario), Canada.





**Fisher**  
M-SCOPE  
PIPEFINDERS

1<sup>st</sup> choice  
for  
**DEPENDABILITY!**

Rugged transistorized construction practically eliminates maintenance costs...extends battery life to a year or more. Pinpoint accuracy, greatest depth penetration make the M-scope first choice in the field! Only \$189.50

Send for FREE catalog

SINCE 1932  
**Fisher RESEARCH LAB., INC.**

Dept. PW-7, Palo Alto, Calif.

## VISI-METER TURNS YOUR METER READING INSIDE-OUT!



Remote registry for WATER or GAS METERS

A practical remote indicator and recording system. Tested and approved. Now used by 90 cities. Visi-Meter eliminates city expense and liability of controlling keys to customers' residences. Easily read in one trip by meter readers.

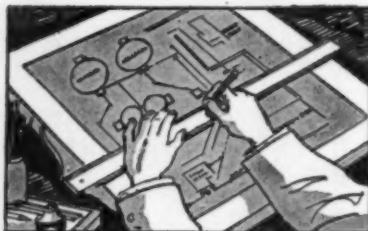
- Accurate within .01%
- Requires minimum up-keep
- Protected with Tamper proof seals

This Product Is Manufactured and Guaranteed by

**VISI-METER, INC.**

301 NORTH 17th STREET, KANSAS CITY, KANSAS

# CONSULTING ENGINEERS



**CITY, COUNTY**

**AND STATE**



**PHOTOGRAMMETRIC ENGINEERING •**  
**ALSTER & ASSOCIATES, INC. TOPOGRAPHIC & PLANIMETRIC MAPS •**  
**AERIAL MOSAICS • PRECISE FIELD SURVEYS**  
 6135 Kansas Ave., N.E. • TA 9-1167 • Washington 11, D. C.

## **Brockway, Weber & Brockway** ENGINEERS INCORPORATED

Land Planning, Civil, Structural,  
Municipal and Electrical Engineering  
Reports, Plans, Specifications &  
Supervision

Home Office  
West Palm Beach, Fla.

Branch Office  
Ft. Pierce, Fla.

## **GIBBS & HILL, Inc.**

Consulting Engineers

Industrial Wastes	Electric Transmission & Distribution Systems	Airports
Water & Sewage Works	Convention & Nuclear Power Generation	Rapid Transit
Hydraulic Developments	Power & Surveys & Contracts	Highways & Bridges

PENNSYLVANIA STATION NEW YORK 1, N.Y.

**JOHN McNAIR**  
WAYNESBORO, VA.

**M. T. DECKER**  
CHARLOTTESVILLE, VA.

AND ASSOCIATES

CONSULTING CIVIL ENGINEERS  
STUDIES, REPORTS, DESIGN, CONSTRUCTION SUPERVISION,  
HIGHWAYS, AIRPORTS, UTILITIES  
COMMUNITY FACILITIES

## **ROBERT AND COMPANY ASSOCIATES**

Municipal Engineering Division  
ATLANTA

WATER SUPPLY, SEWAGE DISPOSAL, INCINERATORS, POWER PLANTS



**Abrams Aerial Survey**  
*Corporation*  
Photogrammetric Services

AERIAL PHOTOGRAPHY,  
TOPOGRAPHIC MAPS,  
ATLAS SHEETS AND MOSAICS  
IVanhee 4-9441 Lansing, Michigan

## **ALBRIGHT & FRIEL INC.**

Consulting Engineers

Water, Sewage, Industrial Wastes and  
Incineration Problems  
City Planning Highways, Bridges and Airports  
Dams, Flood Control, Industrial Buildings  
Investigations, Reports, Appraisals and Rates  
THREE PENN CENTER PLAZA  
PHILADELPHIA 2, PENNSYLVANIA

## **AERO SERVICE CORPORATION**

Aerial topographic maps — photo-maps or engineering projects anywhere in the world — highways, railroads, cities, power and pipe lines, mining development. Soil studies and electronic surveys of large areas; resources inventories.

210 E. Courtland

Philadelphia 20

## **ALVORD, BURDICK & HOWSON**

Engineers

Water Works, Water Purification,  
Flood Relief, Sewage, Sewage Disposal, Drainage, Appraisals, Power Generation

20 No. Wecker Dr.

Chicago 6, Ill.

## **AMERICAN AIR SURVEYS, INC.**



Aerial Topo Maps  
Aerial Photos & Mosaics  
Plan & Profile  
Tax Maps

907 PENN AVE., PITTSBURGH 22, PENNA.  
BRANCHES: MANHASSET, N.Y. • ATLANTA, GA.  
A Nationwide Service

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St., Ridgewood, N.J.

## **MICHAEL BAKER, JR., INC.**

THE Baker Engineers

Civil Engineers, Planners, and Surveyors  
Airports, Highways, Sewage Disposal Systems,  
Water Works Design and Operation—  
City Planning—Municipal Engineering—  
All types of Surveys

Home Office: Rochester, Pa.

Branch Offices:  
Jackson, Miss. Harrisburg, Pa.

## **BANISTER ENGINEERING CO.**

Consulting Engineers

"Staffed to completely fill municipal requirements for professional service"

310 No. Snelling Ave. Tel. Midway 6-2612  
St. Paul 4, Minnesota

## **BARNARD AND BURK**

Consulting Engineers

Municipal and Industrial Engineering Surveys,  
Reports, Waterworks, Sewerage and Sewage Disposal,  
Revenue Projects, Natural Gas, Light and Power, Streets and Highways, Harbor and Port Developments

1023 Nicholson Drive  
Baton Rouge, Louisiana

## **E. D. BARSTOW & ASSOCIATES**

Engineers

Water Supply, Treatment, Distribution  
Sewage Collection, Treatment, Disposal  
Trade Waste Treatment

163 N. Union St.

Akron 4, Ohio

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St.

Ridgewood, N.J.



**HOWARD K. BELL**

Consulting Engineers, Inc.

Water Works      Swimming Pools  
Industrial Wastes      Garbage Disposal  
Sewerage      Drainage  
Valuations      Rates      Reports  
Operation Supervision

553 S. Limestone St.      Lexington, Ky.



**BENHAM  
ENGINEERING COMPANY**  
Consulting Engineers  
215 NE 23rd Oklahoma City  
Established 1909

**Bonham, Kuck, Grant and Brundage**

H. E. BONHAM      NYE GRANT  
CARL E. KUCK      J. M. BRUNDAGE

Consulting Engineers

Sewage and Industrial Waste Treatment  
Water Supply and Purification  
4954-58 N. High St.      Columbus 14, Ohio

**BLACK & VEATCH**

Consulting Engineers

Water-Sewage-Gas-Electricity-Industry  
Reports, Design, Supervision of Construction  
Investigations, Valuations and Rates

1300 Meadow Lake Pkwy., Kansas City 14, Mo.

**CLINTON BOGERT ENGINEERS**

Consultants

Clinton L. Bogert      Ivan L. Bogert  
Donald M. Dittmars      Robert A. Lincoln  
Charles A. Manganaro      William Martin  
Water & Sewage Works      Incinerators  
Drainage      Flood Control  
Highways and Bridges      Airfields

145 East 32nd Street, New York 16, N.Y.

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St.      Ridgewood, N.J.

**BOWE, ALBERTSON & ASSOCIATES**

Engineers

Water and Sewage Works  
Industrial Wastes  
Refuse Disposal  
Valuations  
Laboratory Service  
75 West St.      1000 Farmington Ave.  
New York 6, N.Y.      West Hartford 7, Conn.

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St.      Ridgewood, N.J.

**BOYLE ENGINEERING**

Architectural &amp; Engineering Consultants

Water-Development, Treatment, Storage, Dis-  
tribution, Sewage Collection, Sewage Treat-  
ment, Refuse.  
Waste Disposal-Industrial, Commercial, Residen-  
tial, Municipal, Highways, Streets, Bridges,  
Parks, Harbors, Flood Control, Special Dis-  
tricts, Civic, Industrial, Commercial Buildings,  
Structures, Site Planning.  
Bakersfield      Santa Ana      San Diego  
California

**Floyd G. Browne and Associates**

Consulting Engineers

F. G. Browne      S. W. Kuhner  
W. G. Smiley      G. M. Hinkamp  
C. R. Martin      W. H. Kuhn  
Water Supply and Purification - Sewage and  
Industrial Waste Treatment - Refuse Dis-  
posal - Electric Systems - Surveys - Reports  
Valuation and Rates  
Marion, Ohio

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St.      Ridgewood, N.J.

**BROWN ENGINEERING CO.**

Consulting Engineers

Waterworks, Sewage Disposal, Airports  
Street Improvements, Power Plants  
Electric Distribution, Rates  
508 TENTH STREET      DES MOINES 9, IOWA

**BUCK, SEIFERT AND JOST**

Consulting Engineers

Water Supply      Sewage Disposal  
Hydraulic Developments  
Reports, Investigations, Valuations  
Rates, Design, Consultation, Operation  
Management, Chemical and  
Biological Laboratories

112 East 19th St.      New York City

**BURGESS & NIPLÉ**

Consulting Engineers

Established 1908

Water supply, treatment and distribution  
Sewage and industrial wastes disposal  
Investigations, reports, appraisals, rates  
Airports, Municipal Engineering, Supervision

2015 West Fifth Ave.      Columbus 12, Ohio

**RALPH H. BURKE, INC.**

Consulting Engineers

Traffic Studies      Underground Garages  
Parking structures      Grade separations  
Expressways, Airports and Terminal Buildings  
Shore Protection      Municipal Engineering  
Parks      Field Houses      Swimming Pools

20 North Wacker Drive, Chicago 6, Ill.

**BURNS & McDONNELL**

Engineers - Architects - Consultants

4600 E. 63rd St., TRAFFICWAY  
KANSAS CITY 41, MISSOURI

**J. W. BURT**

Civil Engineer and Designer

Specializing In

ROADS AND BRIDGES

PHONE 1701      P.O. BOX 361  
McCOMB, MISSISSIPPI

**CARL BUSSOW**Consulting Chemist and  
Paving Engineer

Specialist on  
Asphalt Petroleum and  
Tar Products

801 Second Ave.      New York 17, N.Y.

**CAMP, DRESSER & McKEE**

Consulting Engineers

Water Works and Water Treatment  
Sewerage and Sewage Treatment  
Municipal and Industrial Wastes  
Investigations and Reports  
Design and Supervision  
Research and Development  
Flood Control

18 Tremont Street      Boston 8, Mass.

**Capitol Engineering Corporation**

Consulting Civil Engineers

Dillsburg, Pennsylvania, U.S.A.

**JOHN A. CAROLLO**

Consulting Engineers

Water Supply and Purification, Sewage  
Sewage Treatment, Power Generation and  
Distribution, Gas Systems, Valuations  
3308 N. Third St., Phoenix, Arizona  
2168 Shattuck Ave., Berkeley 4, Calif.

**HOMER L. CHASTAIN & ASSOCIATES**

Consulting Engineers

Civil, Structural, Mechanical, Industrial Design  
& Supervision, Construction, Engineering, Turn-  
pikes, Bridges, Water Supply, Sewerage, Flood  
Control & Drainage, Material Controls, Municipal  
Engineering, Topographic Surveys.

155 1/2 West Main Street      Decatur, Illinois

**THE CHESTER ENGINEERS**

Water Supply and Purification  
Sewage and Industrial Waste Treatment  
Power Plants-Incineration-Gas Systems  
Valuations-Rates-Management  
Laboratory-City Planning

601 Swaiman Street, Pittsburgh 12, Penna.

**CHICAGO AERIAL SURVEY**

PHOTOGRAMMETRIC ENGINEERS

Aerial photography since 1923. Complete  
photogrammetric services for city, county,  
highway and consulting engineers.  
Developers of Sonar Strip Photography  
• Base maps and atlas sheets • Precise topo-  
graphic maps for sewerage studies, construction  
planning and site location • Scaled mosaics and  
pictorial presentations • Highway studies. Street  
and road maps. Sonar photography.  
10265 FRANKLIN AVE., FRANKLIN PARK, ILL.  
A Division of Chicago Aerial Industries, Inc.

**FOR RATES FOR THIS SPACE**

WRITE

**PUBLIC WORKS MAGAZINE**

200 So. Broad St., Ridgewood, N.J.

**CLARK, DAILY AND DIETZ**

Consulting Engineers

Sewerage, Waterworks, Street Lighting, High-  
ways, Swimming Pools, Surveying and Mapping,  
Land Development Studies, Bridges, Buildings,  
Foundations.  
211 North Race St.      188 Jefferson St.  
Urbana, Illinois      Memphis, Tennessee

**CLARK & GROFF ENGINEERS**

Consulting Engineers

Civil, Sanitary & Municipal Engineering  
Investigations, Reports, Plans  
Supervision of Construction  
Laboratory

3240 Triangle Dr.      Salem, Oregon

**CHAS W. COLE & SON***Engineers—Architects*

3400 E. Jefferson Blvd. 2112 W. Jefferson St.  
 South Bend, Indiana Joliet, Illinois

**CONSOER, TOWNSEND & ASSOC.  
—CONSULTING ENGINEERS—**

Sewerage treatment, sewers, storm drainage, flood control—water supply and treatment—Highway and bridges—Airports—Urban renewal—Electric and gas transmission lines—Rates studies, surveys and valuation—Industrial and institutional buildings.

360 EAST GRAND AVENUE  
 CHICAGO 11, ILLINOIS

**CRAWFORD, MURPHY & TILLY**  
*Consulting Engineers*

Water Works—Impounding Reservoirs  
 Highways—Municipal Streets—Expressways  
 Traffic Problems—Airports—Swimming Pools  
 Sewers—Sewage Treatment—Wastes Treatment  
 Storm Drainage—Flood Control—Surveys & Reports

755 So. Grand Ave., W. Lakeside 8-3619  
 Springfield, Ill.

**ALFRED CREW***Consulting Engineers*

Water Supply, Treatment and Distribution  
 Sewerage and Sewage Disposal  
 Drainage and Industrial Wastes

45 N. Broad St. Ridgewood, N.J.

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St. Ridgewood, N.J.

**DE LEUW, GATHER & COMPANY***Consulting Engineers*

Public Transit Subways  
 Traffic & Parking Railroad Facilities  
 Expressways Industrial Plants  
 Grade Separations Municipal Works  
 Urban Renewal Port Development

150 North Wacker Drive, Chicago 6  
 San Francisco New York Toronto Boston

**H. G. DILL COMPANY***Consulting Engineers*

H. G. Dill G. W. Heckaden  
 B. W. Lipps J. A. Rousculp  
 H. J. Roberts P. Friede  
 Civil, Sanitary, Structural, Municipal, Highway,  
 Subdivision, Planning, Property Surveys, Topo-  
 graphic Surveys, Reports, Appraisals.  
 2607½ No. High St. Columbus 2, Ohio  
 AM 2-9744

**NORMAN O. ELDRED***Consulting Engineer*

Water Supply and Distribution Systems, Municipal and Industrial Water Conditioning Equipment, Steam Power Plants, Diesel-Electric Power Plants, Electric Systems, Street Lighting, Pavements, Airports, Drainage, Sewage Treatment, Trade Wastes Disposal, Municipal Incinerators, Industrial Plant Designs, Propane & Butane Storage & Vaporizer Plants.  
 P.O. Box 3396 Merchandise Mart Postal Sta.  
 Chicago 54, Illinois

**ROY B. EVERSON**

Water Treatment Service Since 1900 for Swimming Pool Circulating Systems, Purification Systems as applied to Sewage Treatment and Water Works. A New System for Automatic Control.

237 W. Huron Street, Chicago 10, Ill.

**FAY, SPOFFORD & THORNDIKE, INC.***Engineers*

Airports—Bridges—Express Highways  
 Industrial Bldgs.—Incinerators—Port Developments  
 Water Supply—Drainage and Sewerage Systems  
 11 Beacon Street, Boston, Mass.

**FINKBEINER, PETTIS & STROUT***Consulting Engineers*

Water Supply, Water Treatment,  
 Sewerage, Sewage Treatment,  
 Bridges, Highways & Expressways

2130 Madison Avenue Toledo 2, Ohio

**WALTER H. FLOOD & CO.***Chemical Engineers*

Inspection and Testing of Materials and Structures  
 Streets—Roads—Airports  
 Building and General Engineering Construction  
 Resident Inspection—Chemical & Physical Tests  
 Soil Boring & Investigation—Concrete Core Cutting  
 Specifications—Reports—Research

6102 S. Blackstone Ave. Chicago 37, Ill.

**FRIDY, GAUKER, TRUSCOTT & FRIDY, INC.***Engineers*

Hospitals, Schools, Industrial Buildings,  
 Public Buildings, Airports, Roads, Water,  
 Sewage, Petroleum Facilities, Waste Dis-  
 posal, Power & Lighting, Reports, Plans,  
 Supervision, Appraisals.

1321 Arch Street Philadelphia 7, Penna.

**M. E. FRYE & ASSOCIATES, INC.***CONSULTING ENGINEERS*

Investigations • Reports  
 Civil, Sanitary & Municipal Engineering  
 Planning • Designs • Supervision

428 Blvd. of Allies 166 E. Union St.  
 Pittsburgh 19, Pa. Somerset, Pa.  
 EXpress 1-0618 SOMerset 6366

**GILBERT ASSOCIATES, Inc.***Engineers and Consultants*

Power Plant Engineering  
 Water Supply and Purification  
 Sewage and Industrial Waste Treatment  
 Chemical Laboratory Service

New York READING, PA. Washington

**GOODKIND & O'DEA***Consulting Engineers*

Foundations, Structures, Highways,  
 Sewerage, Water Supply, Drainage

610 Bloomfield Ave., Bloomfield, N.J.  
 New York, N.Y. Hamden, Conn. Chicago, Ill.

**GREELEY & HANSEN***Engineers*

Water Supply, Water Purification  
 Sewerage, Sewage Treatment  
 Flood Control, Drainage, Refuse Disposal

14 East Jackson Blvd., Chicago 4, Illinois

**HOWARD R. GREEN CO.***Consulting Engineers*

DESIGN AND SUPERVISION OF  
 MUNICIPAL DEVELOPMENTS

Water Works and Treatment—Sewers  
 and Sewage Disposal—Investigations  
 and Valuations  
 208-10 Beaver Bldg., Cedar Rapids, Iowa  
 Established 1913

reduction in industrial waste surcharges, will determine whether or not these pretreatment units will be installed. The deciding factor will be the determination of whether the industry can remove the excess of suspended solids and BOD cheaper than the city surcharge rate of \$0.063 per mg per ppm.

While it is too soon to draw definite conclusions which can be proved by statistical data, it does appear that the industrial waste ordinance has reversed the trend toward greater and greater concentrations of pollution above normal in the municipal sewage flow received at the treatment plants. Considering the month of November in which rainfall has not caused excessive dilution from infiltration, the suspended solids concentration of raw sewage averaged 332 ppm, a reduction of 6.75 percent under the average concentration of 356 ppm for August, 1958. Comparison of average BOD for the same two months shows a reduction from 282 to 268 ppm or 4.7 percent. Since total sewage flows have continued to increase, the reductions in total pounds of suspended solids and BOD received for treatment would show even greater percentages of reduction.

We feel that the first year of operation of the Dallas industrial waste ordinance has demonstrated that it is a fair, practical and workable ordinance, and that its effect has been to reduce the load on the city's treatment plants, reduce the hazards to the collection system and treatment units, and to begin to equalize the costs for sewage treatment so that the customers pay more nearly in proportion to the service rendered. These were the purposes to be accomplished by the ordinance.

**Other Articles from  
The Sewerage Digest***(Continued from page 170)*

of the diatom flora and in this manner it can be used as a method to monitor a river or estuary. By Matthew H. Hohn, State College, Bloomsburg, Pa. Journal WPCF, January, 1961.

"Turnpike Sewage Treatment Data Will Aid Designers." Operating results of eight sewage treatment plants at service plazas on the Ohio Turnpike are summarized and correlated with traffic flow. By R. H. Finn, Supt. of Buildings, Ohio Turnpike Commission, Berea, Ohio. Public Works, February, 1961.

"Texas Prepares to Evaluate Radioactive Water Pollution." Background conditions of streams is determined in anticipation of future increases in ra-

# **WILLIAM F. GUYTON AND ASSOCIATES**

Consulting Ground-Water Hydrologists

Underground Water Supplies  
Investigations, Reports, Advice  
307 W. 12th St., Austin 1, Texas  
Phone: GR 7-7165

# **GWIN ENGINEERS, INC.**

Consulting Engineers

Highways Water Supply  
Municipal Sewage Disposal  
Planning Mapping  
Reports, Design, Supervision of Construction,  
Surveys

1200 12th Ave. Altoona, Pa.

# **HARDESTY & HANOVER**

Consulting Engineers

Long Span and Movable Bridges, Hanover  
Brew Bascule, Grade Eliminations, Foundations,  
Expressways and Thruways, Other Structures,  
Supervision, Appraisals, and Reports

101 Park Avenue, New York 17, N.Y.

# **HAVENS AND EMERSON**

A. A. Burger H. H. Mossley  
J. W. Avery F. S. Paloczay  
E. S. Ordway G. H. Abplanalp  
A. M. Mock S. H. Surton  
Frank C. Toller, Consultant

Consulting Engineers

Water, Sewerage, Garbage, Industrial Wastes,  
Valuations—Laboratories

Leader Bldg. Woolworth Bldg.  
Cleveland 14, O. New York 7, N.Y.

# **HAZEN AND SAWYER**

Engineers

Richard Hazen Alfred W. Sawyer  
H. E. Hudson, Jr.

Water and Sewerage Works  
Industrial Waste Disposal  
Drainage and Flood Control

360 Lexington Ave., New York 17, N.Y.

# **HENNINGSON, DURHAM & RICHARDSON, INC.**

Consulting Engineers

Consulting Engineers since 1917 for  
more than 700 cities and towns  
Water Works, Light and Power, Sewerage,  
Paving, Airports, Reports,  
Appraisals, Drainage

2962 Horney St. Omaha 2, Nebr.

# **HILL & HILL**

Engineers

Sewage and Waste Disposal.  
Water Supply and Filtration.  
Dams, Reservoirs, Tunnels.  
Airport and Topographic Surveys

Home Office: 8 Gibson St., North East, Pa.

# **HAROLD HOSKINS & ASSOCIATES**

Consulting Engineers

Sewers and Sewage Treatment  
Paving Water Supply Drainage  
Bridges Airports Reports  
Aerial Photogrammetry  
Power Plants Surveys

1630 Que St., Lincoln 8, Nebr.  
1018 Eight Avenue, Greeley, Colorado

# **MARK HURD AERIAL SURVEYS, INC.**

Topographic and Planimetric Maps  
Tax Maps Aerial Photography

345 Pennsylvania Avenue South  
Minneapolis 26, Minnesota

# **Jenkins, Merchant & Nankivil**

Consulting Engineers

Municipal Improvements Gas Systems  
Highways & Airports Water Systems  
Power Development Sewerage Systems  
Traffic Surveys Industrial Plants  
Flood Control Recreational Facilities  
Investigations and Reports  
801-805 East Miller St., Springfield, Ill.

# **JOHNSON DEPP & QUISENBERRY, INC.**

Consulting Engineers

Highways Water Supply  
Planning Sewage Disposal  
Surveys

2625 Frederica St. Owensboro, Ky.

# **JOHNSON SOILS ENGINEERING LABORATORY**

Laboratory and Field Testing  
Shear and Consolidation Tests  
Design and Construction Control

MOBILE LABORATORIES

193 West Shore Avenue  
Bogota, New Jersey

# **JONES HENRY & WILLIAMS**

Consulting Sanitary Engineers

Water Works  
Sewerage and Treatment  
Waste Disposal

2000 West Central Avenue Toledo 6, Ohio

# **EDWARD C. JORDAN CO., INC.**

Civil & Sanitary Engineers

Sewerage • Sewage Disposal • Industrial Wastes  
Drainage • Water Supply • Streets • Highways  
Municipal Engineering

Investigations—Reports—Designs—Supervision

379½ Congress St., Portland, Maine  
Tel. SP 4-0315

# **KENNEDY ENGINEERS**

Complete Public Works Engineering

• Water Supply  
• Sewage and Waste Treatment  
• Sewage Reclamation  
• Utilities Planning

CHEMICAL and BIOLOGICAL LABORATORY  
SAN FRANCISCO

Los Angeles Tacoma Salt Lake City

# **KEIS & HOLROYD**

Consulting Engineers

(Formerly Solomon & Keis)  
Since 1896

Water Supply, Sewage Disposal, Garbage &  
Refuse Incineration, Industrial Buildings

Troy, N.Y.

# **FENTON G. KEYES ASSOCIATES**

Consulting

ARCHITECT-ENGINEERS

Providence 3, R.I. Waltham 54, Mass.

# **KOEBIG & KOEBIG, INC.**

ENGINEERING — ARCHITECTURE  
MUNICIPAL PLANNING

Reports Investigations Designs  
Consultants to Cities Since 1916

3242 W. 8th Street, Los Angeles 5, California  
715 Bank of America Building,  
625 Broadway, San Diego, California

# **MORRIS KNOWLES INC.**

Engineers

Water Supply and Purification, Sewage  
and Sewerage Disposal, Industrial Waste,  
Valuations, Laboratory, City Planning

1312 Park Building, Pittsburgh 22, Pa.

# **KREHBIEL & KREHBIEL<sup>®</sup> engineers**



Consulting

DRAINAGE REPORTS  
HIGHWAYS SEWERAGE  
ICE RINKS SUBDIVISIONS  
PLANNING SURVEYS  
POOLS WATER

1868 NIAGARA FALLS BOULEVARD • TONAWANDA, N. Y.

# **LADD ENGINEERING CO.**

Consulting Engineers

Sewers, Water, Paving,  
Filter Plants, Disposal Plants,  
Electric Systems

Southeastern States

Home Office: FORT PAYNE, ALA.

# **LORENZI, DODDS and GUNNILL**

Berger Building

Pittsburgh 19, Pennsylvania

Consulting Engineers

Serving

Pennsylvania, Ohio and West Virginia

# **LOZIER CONSULTANTS, INC.**

Engineers

Sewerage, Sewage Disposal, Waste  
Supply, Water Purification, Refuse  
Disposal

10 Gibbs Street

Rochester 4, N.Y.

# **MCCREARY • KORETSKY • ENGINEERS**



PLANNING-DESIGN-REPORTS  
FOR  
MUNICIPAL FACILITIES

1140 Howard Street  
San Francisco, Calif.

5675 Freeport Blvd.  
Sacramento, Calif.

# **FOR RATES FOR THIS SPACE**

write

# **PUBLIC WORKS MAGAZINE**

200 So. Broad St.

Ridgewood, N.J.

# **MADDOX AND HOPKINS**

Engineers and Surveyors

Highways, Utilities, Structures  
Topographic Maps — Photogrammetry  
Plans and Geodetic Surveys

8506 Dixon Ave.

Silver Spring, Md.

# **GEORGE B. MEBUS, INC.**

Consulting Engineers

Sewerage — Industrial Wastes  
Water Supply — City Planning  
Investigations and Reports  
Design and Supervision of Construction  
Valuations

Broad Street Trust Co., Bldg.  
Glenside, Pa.



**MERRITT & WELKER***Engineers*

Water, Sewage, Streets, Roads, Natural Gas,  
Valuations, Municipal Planning

208 Roswell Street Marietta, Georgia

**METCALF & EDDY***Engineers*

Soils, Foundations, Waterworks, Sewage Works,  
Drainage, Irrigation, Flood Control, Refuse,  
Industrial Wastes, Airports, Highways, Military  
Projects, Industrial and Commercial Facilities.

Stetler Building, Boston 16, Massachusetts

**MORAN, PROCTOR, MUESER  
& RUTLEDGE***Consulting Engineers*

Foundations for Buildings, Bridges and Dams;  
Tunnels, Bulkheads, Marine Structures;  
Soil Studies and Tests, Reports,  
Design and Supervision

415 Madison Ave. New York 17, N.Y.  
Eldorado 5-4860

**GEORGE V. R. MULLIGAN, P.E.***Management Consultant*

Operation Analysis  
Manpower Utilization  
Management Controls

601-19th Street, N.W. Washington, D.C.

**NUSSBAUMER-CLARKE and VELZY***Consulting Engineers*

Sewage Treatment—Water Supply  
Incineration—Drainage—Highway Planning  
Appraisals and Rate Studies

327 Franklin St., Buffalo 2, N.Y.  
500-5th Ave., New York 36, N.Y.

**O'BRIEN & GERE***Consulting Engineers*

Water Supply, Treatment, and Distribution  
Sewage and Sewage Treatment  
Industrial Waste Treatment—Flood Control  
and Drainage

Rates Studies—Development Planning—Surveys  
400 East Genesee Street Syracuse 2, N.Y.

**PARSONS, BRINCKERHOFF  
QUADE & DOUGLAS***Civil & Sanitary Engineers*

Water, Sewage, Drainage and  
Industrial Waste Problems,  
Structures—Power—Transportation

165 Broadway New York 6, N.Y.

**E. LIONEL PAVLO***Consulting Engineer*

Design, Supervision, Reports  
Bridges, Highways, Expressways  
Marine Structures, Public Works  
Industrial Construction, Airports

642 Fifth Ave. New York 19, N.Y.

**MALCOLM PIRNIE ENGINEERS**

Malcolm Pirnie  
Ernest W. Whitlock  
Robert D. Mitchell  
Carl A. Arenander  
Malcolm Pirnie, Jr.  
Alfred C. Leonard

*ENGINEERS—BIOLOGISTS—CHEMISTS*

Water Supply — Water Treatment  
Sewage and Waste Treatment  
Drainage — Rates — Refuse Disposal

25 West 43rd St. New York 36, N.Y.  
3013 Huron St. Tampa 9, Florida

**THE PITOMETER ASSOCIATES, INC.***Engineers*

Water Waste Surveys  
Trunk Main Surveys  
Water Distribution Studies  
Water Measurement and Special  
Hydraulic Investigations

50 Church St., New York City

**PRAEGER-KAVANAGH***Engineers*

126 E. 38th St. New York 16, N.Y.

**RADER AND ASSOCIATES***Engineers—Architects*

Water Works, Sewers, Sewage Disposal and  
other Public Works Projects, Hotels, Office,  
Industrial and Commercial Buildings  
Plans, Specifications, Supervision, Reports  
Investigations, Consultations  
Aerial Photography, Photogrammetry  
The First National Bank Bldg., Miami 32, Florida  
Phone Franklin 1-3551

**ROY EDWIN RAMSEIER  
AND ASSOCIATES***Sanitary and Hydraulic Engineers*

Water Supply, Treatment, Distribution  
Sewerage and Sewage Treatment  
Chemical and Bacteriological Laboratories

1539 Solano Avenue, Berkeley 7, California

**DALE H. REA***Consulting Engineers*

Water Supply and Treatment, Sewage Col-  
lection and Treatment, Irrigation, Reservoirs  
and Dams, Airports, Buildings and Bridges  
Appraisals — Reports — Specifications  
Supervision of Construction

2200 West Channing Littleton, Colorado  
PY. 4-3546

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St. Ridgewood, N.J.

**RIPPLE AND HOWE, Inc.***Consulting Engineers***APPRAISALS AND REPORTS****DESIGN AND SUPERVISION**

Water Works Systems, Filtration Plants,  
Irrigation and Drainage Systems, Reser-  
voirs and Dams, Sanitary and Storm Sewer  
Systems, Sewage Treatment Plants, and  
Refuse Disposal.

O. J. Ripple V. A. Vaseen B. V. Howe  
2747 Juni St. Denver 11, Colo.

**RUSSELL AND AXON***Consulting Engineers*

Civil—Sanitary—Structural

Industrial—Electrical

Rate Investigations

408 Olive St., St. Louis 2, Mo.  
Municipal Airport, Daytona Beach, Fla.

**CARL SCHNEIDER***Consulting Engineers*

Incineration  
Refuse Collection  
Sanitary Fills  
Sanitation Studies  
Reports

602 Pan American Bldg.  
New Orleans 12, La.

radioactive pollution. By H. A. Bevis, Chief, Ionizing Radiation Program, Division of Occupational Health, Texas State Department of Health, Austin, Texas. *Public Works*, February, 1961.

**"Do Radioactive Materials Affect Sludge Digestion?"** Studies reveal what happens to sludge digestion in the presence of carrier-free Iodine-131. By Werner N. Grune, Chun-Fei Chueh and Roy Peek, Prof. of Sanitary Engineering and Research Assistants, respectively, Sanitary Engineering Research Laboratories, School of Civil Engineering, Georgia Institute of Technology. *Wastes Engineering*, January, 1961.

**"Excavation and Pipe Foundations for Sewage Collection Systems."** This article serves as a review of some of the more important things to consider and of the methods that make an installation a successful one. By Kent S. Kaser, Sanitary Engineer, William Matolan & Associates, Albuquerque, New Mexico. *Water & Sewage Works*, January, 1961.

**Gas Scrubbing***(Continued from page 114)*

gas of less than 60 gr. per 100 cf, which is suitable for use in the gas engines.

4) A gas to water ratio of 2 to 1 proved adequate to produce a satisfactory scrubbing action.

5) Of the various chemicals known to react with H<sub>2</sub>S, hypochlorite (or Cl<sub>2</sub>) alone was found advantageous as a "scrubber aid."

6) The CO<sub>2</sub> content of the gas is reduced from 35 to 25 percent, enriching the gas proportionately.

**Acknowledgment**

D. P. Backmeyer and Ken Drautz, Superintendent and Chemist respectively of the Miami Sewage Treatment Plant, and personnel of the Pacific Flush Tank Company, actively participated in planning and carrying out the work herein reported.

**References**

1. Norris, Harold E., "Scrubbing Sewage Gas," *Water Works and Sewerage*, 90, 61 (1943).
2. Report on a study of sulfate content of sewage by Clarence Henry, Dept. of Water and Sewers, City of Miami.
3. Langmuir, I., "The Absorption of Gases on Plane Surfaces of Glass, Mica, and Platinum," *J. American Chemical Society*, 40, 1361-1403 (1918).
4. Buswell and Neave, Illinois State Water Survey B25, 27 (1928).
5. Black, A. P. and Goodson, James B., Jr., "The Oxidation of Sulfides by Chlorine in Dilute Aqueous Solutions," *J. American Water Works Association*, 44, 309 (1952).

*Condensed from a paper at the Fifteenth Purdue Industrial Waste Conference, 1960.*

**IRBY SEAY COMPANY***Engineers—Consultants*Water Supply & Treatment      Natural Gas Systems  
Sewage System & Treatment      Electrical514 Goodwyn Inst. Bldg. Phone Jackson 7-3301  
Memphis, Tennessee**SEELYE STEVENSON VALUE & KNECHT***Consulting Engineers*Richard E. Dougherty, Consultant  
Civil, Mechanical, Electrical  
Airports, Highways, Bridges, Industrial  
Plants, Dams, Water Supply, Sanitation,  
Tunnels, Piers, Reinforced Concrete, Steel  
101 Park Avenue      New York 17, N.Y.**SERVIS, VAN DOREN & HAZARD***Engineers—Architects*  
Construction • AppraisalsInvestigations • Design • Supervision of  
Water • Sewage • Streets • Expressways • High-  
ways • Bridges • Foundations • Airports • Flood  
Control • Drainage • Aerial Surveys • Site Plan-  
ning • Urban Subdivisions • Industrial Facilities  
Electrical • Mechanical  
2910 Topeka Blvd.      Topeka, Kansas**SMITH & GILLESPIE***Municipal and Consulting Engineers*Water Supply, Water Purification  
Sewerage, Sewage Disposal, Drainage  
Refuse Disposal, Gas Systems, Power Plants  
Airports

Jacksonville      Florida

**FOSTER D. SNELL, Inc.**

29 West 15th St., New York 11, N.Y.

WATKINS 4-8800

Chemists, Engineers, Bacteriologists,  
Toxicologists, Market Research,  
10 stories of laboratories with  
a staff of over 130.

YOUR INQUIRY ANSWERED PROMPTLY

**SOIL TESTING SERVICES, INC.***Consulting Engineers*CARL A. METZ      JOHN P. GNAEDINGER  
Soil Investigations  
Foundation Recommendations and Design  
Laboratory Testing  
1827 No. Harlem Ave.      Chicago 35, Ill.  
San Francisco      Milwaukee, Wis.  
Havana, Cuba      Portland, Michigan**SPRAGUE & HENWOOD, INC.***Drilling Services*Foundation Investigations      Test Boring  
Great Hole Drilling and Pressure Grouting  
Diamond Core Drilling  
221 W. Olive St., Scranton, Pa.  
New York, Philadelphia, Pittsburgh, Nashville  
Grand Junction, Colorado, Tucson  
Bucks, Newfoundland**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St., Ridgewood, N.J.

**STANLEY ENGINEERING COMPANY***Consulting Engineers*Hersey Building      Muscatine, Iowa  
208 S. LaSalle St.      Chicago 4, Illinois  
1154 Hanna Building      Cleveland 15, Ohio**ROBERT H. STELLWAGEN***Consulting Engineers*Municipal and Industrial Waste Problems  
Collection, Incineration, Salvage, Pumping,  
Treatment, Testing

1442 E. Outer Drive      Detroit 34, Mich.

**ALDEN E. STILSON & ASSOCIATES***Consulting Engineers*Water Supply, Sewerage, Industrial Waste  
Bridges—Highways—Industrial Structures  
Mechanical & Industrial Layouts & Studies  
Land Use Planning & Industrial Parks245 N. High St.      75 Public Square  
Columbus, Ohio      Cleveland, Ohio  
54 14th St.      Wheeling, W. Va.**STETSON, STRAUSS & DRESSLEHAUS, INC.***Civil & Consulting Engineers*Los Angeles      Oceanside      Porterville  
INVESTIGATIONS • REPORTS • DESIGNS • ESTIMATES  
Water Supply, Drainage, Sewerage, Municipal  
Works, Foundations, Materials Testing, Surveying  
& Mapping.

Main Office: 215 W. 7th St., Los Angeles, Calif.

**SUHR, PETERSON, PETERSON & SUHR***Consulting Engineers*

REPORTS—PLANS—SUPERVISION

Sewerage, Water Supply, Flood Control  
and Drainage, Airports, Roads, Surveys,  
Fixed and Movable Bridges.  
130 N. Wells St.      Chicago 6, Illinois**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St.      Ridgewood, N.J.

**WALLACE & HOLLAND***Consulting Engineers*MUNICIPAL      SANITARY      STRUCTURAL  
Streets      Pollution Control      Bridges  
Airports      Swimming Pools      Buildings  
Planning      Storm Drainage      Storage Bins  
Expressways      Water Supply      Investigations  
401 North Federal Avenue, Mason City, Iowa**JOSEPH S. WARD & ASSOCIATES***Consulting Soil and Foundation Engineer*Site Investigation, Boring Supervision, Labora-  
tory Soils Testing, Foundation and Pavement  
Analysis and Design, Construction Supervision,  
Engineering Reports and Consultation.91 Rossland Avenue      Coldwell, N.J.  
Jefferson Bldg.      Philadelphia, Penna.**J. STEPHEN WATKINS**

J. E. Watkins      G. R. Watkins

*Consulting Engineers*Municipal and Industrial Engineering, Water  
Supply and Purification, Sewerage and Sewage  
Treatment, Highways and Structures, Reports,  
Investigations and Rate Structures.446 East High Street      Lexington, Kentucky  
Branch Office  
2617 Dixie Highway      Louisville, Kentucky**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St.      Ridgewood, N.J.

**FOR RATES FOR THIS SPACE**

write

**PUBLIC WORKS MAGAZINE**

200 So. Broad St.      Ridgewood, N.J.

**WELCH AND MALINOFSKY***Consulting Engineers & Geologists*• Soils and Foundations  
• Engineering Geology  
• Photo-Interpretation382 Springfield Ave., Summit, N.J.  
CRestview 7-1323**ROY F. WESTON, INC.***ENGINEERS—BIOLOGISTS—CHEMISTS*Industrial Wastes—Stream Pollution  
Air Pollution—Water Sewage  
Surveys—Research—Development—Process  
Engineering—Plans and Specifications  
Operation Supervision—Analysis  
Evaluations and Reports

NEWTOWN SQUARE, PA.

**WALTER H. WHEELER EM., M. A. S. C. E.***Designing and Consulting Engineer*Buildings, Bridges, Mfg. Plants, Etc.  
Inventor "Smooth Ceilings" Flat Slab  
Construction802 Met. Life Bldg.      Minneapolis, Minn.  
Tel. Federal 3-1019**WHITMAN, REQUARDT and Associates**Civil—Sanitary—Structural  
Mechanical—Electrical

Reports, Plans, Supervision, Appraisals

1304 St. Paul St., Baltimore 2, Md.

**CLYDE E. WILLIAMS & ASSOCIATES, INC.**Aerial Mapping  
Civil & Sanitary Engineering312 W. Colfax Ave., South Bend 1, Ind.  
720 E. 39th St., Indianapolis 5, Ind.**WILSEY, HAM & BLAIR***Engineers & Planners*Water and Sewerage Works  
Flood Control and Drainage  
Airports, Traffic Studies and Bridges  
City and Regional Planning111 Rollins Road, Millbrae, Calif.  
800 W. Colorado Blvd.  
Los Angeles 41, Calif.**WILSON & COMPANY***Engineers*Water, Sewerage, Streets, Highways, Dams,  
Bridges, Electrical, Airfields, Drainage  
Treatment Plants, Industrial Installations.  
Chemical Testing Lab—Aerial Mapping  
Electronic Computer Services

631 E. CRAWFORD      SALINA, KANSAS

**J. C. ZIMMERMAN ENGINEERING CO.***Consulting Engineers*Water Supply and Treatment  
Drainage—Flood Relief  
Sewerage and Sewage Treatment  
Planning Design Supervision  
11121 West Oklahoma Avenue  
West Allis 19, Wisconsin

## PUBLIC WORKS EQUIPMENT NEWS

### Electric Tractor



This line of Pacemaker diesel-electric tractors is designed for heavy-duty pushing and dozing; the tractors are all-wheel drive machines with individually powered LeTourneau electric wheels for propulsion. In this system each wheel has its own DC electric motor and gear reduction built inside the rim. Electric generators are direct coupled to the machines' diesel engines to power the motors.

All of the tractors feature the

same power and speed for either direction of travel; electric powered steering; and a high degree of maneuverability, particularly in the three-wheel units. The individually powered electric wheels maintain an almost continuous level of tractive effort despite variations in wheel loading due to turns.

R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Texas.

Circle No. 3-1 on the convenient reply card facing page 34.

### Concrete Plane

The Edco Concrete Plane, a gasoline powered heavy duty unit, is designed to remove excess concrete and asphalt from slabs, roadways, bridge surfaces, airport runways and parking lots. A series of high carbon steel cutters, rotating at high speed and completely adjustable will remove a traffic line or cut the surface of a slab  $\frac{1}{2}$ " and 5" wide. A quick disengage lever gives the operator complete control of the planer. Worn cutter assemblies can be changed in less than 3 minutes.

Equipment Development Company, Inc., 2700 Garfield Ave., Silver Spring, Maryland.

Circle No. 3-2 on the convenient reply card facing page 34.



Removes lines, bumps, cleans joints.

### Submersible Pump

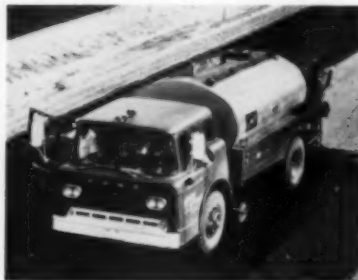
The Model 3VS1 submersible pump is a 3-inch centrifugal, powered by a 5 hp, 3450 rpm, 60 cycle electric motor, and is available in three voltage selections: single phase, 230 volt; three phase, 220 volt; or three phase, 440 volt. Remote control box with overload protection and 75 feet of heavy duty electrical cable are standard equipment with each pump. Complete unit weighs 128 lbs.; pump only 95 lbs. The capacity range, 10 gpm at 120 feet of head to 300 gpm at 10 feet of head. Pump may run in safety if the hole runs dry.

The Gorman-Rupp Co., 305 Bowman St., Mansfield, Ohio.

Circle No. 3-3 on the convenient reply card facing page 34.

### Distributor

The Etnyre FX-500 features a 400 gpm heat-jacketed pump which is heated by engine exhaust directed



into the jacketed pump case surrounding the pump impellers. Tank insulation is 2" fiberglass with asbestos molded blocks for spacers to maintain the full 2" of insulation without compression.

Standard equipment on the FX-500 is Etnyre's full-circulating spray bar with a 92° rotation up from spraying position for complete valve drainage and elimination of drip. Pressure circulation delivers material the instant valves are open. End sections fold on ball bearing hinges.

E. D. Etnyre & Co., Oregon, Ill.

Circle No. 3-4 on the convenient reply card facing page 34.



## Paving Breaker



Requires less air for power output.

A heavy-duty paving breaker, the Davey-Holman Model SS25, has an exceptionally high power-to-weight ratio. Features include heavy alloy steel fronthead and bolts and springs capable of standing up under punishing service. A self-seating poppet-type throttle valve operates in a replaceable bushing which can be readily renewed. Recommended for modern concrete work, the breaker is 31½-in. long, 14 in. wide and weighs 87 lbs.

Davey Compressor Co., Kent, Ohio.

Circle No. 3-5 on the convenient reply card facing page 34.

## Spray Mulch

The application of Soil-Set elastomeric spray mulch polymer emulsion eliminates the need for hay or straw mulch, and can be applied by most standard hydraulic spray units. Once applied, Soil-Set dries in about two hours and from that time on, the area can be watered or irrigated as required. Soil-Set forms a web-like, non-water-soluble coating which stays in place long enough for seeds to germinate. Because it is elastomeric, it resists the forces of wind and water. After germination is completed, Soil-Set decomposes and requires no further attention.

Alco Oil & Chemical Corp., Trenton & Williams St., Philadelphia, Pa.

Circle No. 3-6 on the convenient reply card facing page 34.

## Lane Marker

This traffic lane marking system providing nighttime and bad weather visibility is available as a complete package including reflective, contoured markers, a high strength epoxy-type adhesive for marker-to-pavement bonding, and semi-automatic application which is said to insure maximum in-place life and economy.

Tests indicate that a useful life of 7 to 10 years may be expected from the Lite-Line Markers under extreme traffic conditions. The marker is a low-profile durable plastic disc with impact resistance and flexibility when bonded to the roadway. It contains a uniform dispersion of reflective glass beads which provides brilliance when exposed to vehicle lights. Because of its composition, the marker remains reflective throughout its life. As the grinding action of tires wears it down, new beads are exposed.

American-Marietta Co., 3400 13th Ave., S. W., Seattle 4, Wash.

Circle No. 3-7 on the convenient reply card facing page 34.

## Crawler Tractor

The 750 Crawler tractor features a 301 cu. in. diesel engine; it is equipped with Terromatic transmission, a torque converter that produces up to 23,000 pounds push-pull effort, power shifting, power steering and independent power control of each track. Other features include hydraulic controls, self-lubricating lower track rollers, ease of accessibility to oil and fuel filters and the electrical system.

J. I. Case Co., Racine, Wisconsin.

Circle No. 3-8 on the convenient reply card facing page 34.



## Refuse System

A speedy, mechanized system of refuse handling and pick up, designed to reduce manpower and increase efficiency, employs a highly mobile refuse collection unit called a TrashTainer that rolls on ball-bearing rubber-tired casters. The TrashTainer locks on to the side of the companion truck and packer body unit, called the Quadomatic, and is hydraulically elevated through push-button control to dump refuse into the truck. It takes only one man to operate the entire

system. The TrashTainer units are of leak-proof, corrosion-resistant steel and are available in one and two cu. yd. capacities. A spring-loaded top cover eliminates rodents, insects, spillage and odor. The packer body has a 27 cu. yd. capacity that holds an average payload of 65 yds. when compacted by a powerful hydraulic platen.

The Marion Metal Products Co. TrashTainer System, Marion, Ohio.

Circle No. 3-9 on the convenient reply card facing page 34.



## Crane-Excavator



The compact 250 Bantam is a departure from standard cable-operated power crane-excavators and all-hydraulic machines in that it features both cable and hydraulic operation. All digging and lifting operations are cable operated while an hydraulic system controls the swing. The arc of swing is 370 degrees either right or left. Swing speed is 5.5 rpm.

The unit can operate with five interchangeable front-end attach-

ments: backhoe, crane, dragline, clamshell, and shovel. Available for mounting the Compact 250 Bantam is a crane carrier, the Model 54. The Compact 250 will also mount on any commercial truck having a clearance of at least 80 inches between the center line of the rear axle and the back of the cab.

Schild Bantam Co., Waverly, Iowa.

Circle No. 3-10 on the convenient reply card facing page 34.

## Tamper

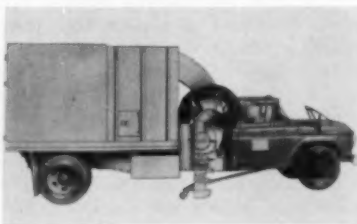
A light-weight ram-type tamper, powered by a four-cycled gasoline engine, the Jay-Ram is suitable for compaction of all types of soil. Operated by one man, this tamper is reported to give maximum compaction of backfill in trenches.

Jay Co., Div. J. Leukart Machine Co., Inc., 2222 S. Third St., Columbus 7, Ohio.

Circle No. 3-11 on the convenient reply card facing page 34.



## Leaf Vacuum



The Leaf-Vac, a truck-mounted sweeper for cleaning leaves from streets and gutters, features a vacuum-operated blower that does an efficient cleaning job through suction. The unit picks up leaves and twigs in a 5-foot swath without dust. A 12-foot flexible snorkel hose attachment is provided for removing matted leaves which accumulate in gutter drains and catch-basins, also for removing piles of leaves from curbside. Power for the vacuum system is provided by an auxiliary engine. A controlled vapor spray is introduced into the suction stream to keep dust down while debris is being loaded and unloaded. Body capacities of 15, 18 and 21 yards are available. Twin ram hydraulic hoists provide automatic dumping.

Baughman Manufacturing Co., Inc., Jerseyville, Ill.

Circle No. 3-12 on the convenient reply card facing page 34.

## All-Purpose Vehicle

The Scout, a small all-purpose vehicle by IHC, designed for transportation of passengers and cargo, is offered in two-wheel or four-wheel drive models, includes a three-person passenger compartment with removable steel top, five-foot long pick-up body, fold-down windshield, removable door glass, removable doors and a four-cylinder engine as standard equipment. A full-length one-piece steel Travel-Top that encloses both driver compartment and body, is optional.

Overall length of both models is 12' 10". Wheelbase is 100 inches. A 52-inch front seat provides three-person passenger comfort. Addition-



al seating is available on two full-length wheel housings in the five-foot integral pickup body. The 152-cubic inch, four-cylinder valve-in-head engine develops approximately 90 horsepower at 4,400 rpm. Optional equipment includes snow plow, winch, power take-off.

International Harvester Co., 180 North Michigan Ave., Chicago 1, Illinois.

Circle No. 3-13 on the convenient reply card facing page 34.

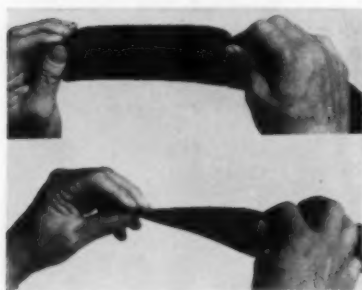
## Potentiometer

For use with strip and circular chart recorders, indicating instruments and controllers, Brown Instruments Div. now provides a drive unit which differs basically from conventional potentiometers. The Electronik 17 uses a strain gage as the rebalancing element, replacing the slidewire. This is said to offer infinite resolution in rebalancing the potentiometer circuit, avoiding the limitations of the convolutions of a slidewire. The new drive unit also features modular construction, which together with the front or display case, also in modular form, permits interchangeability of drive units for different ranges or actuations.

Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrim Avenues, Philadelphia 44, Pa.

Circle No. 3-14 on the convenient reply card facing page 34.

## Joint Sealer



Sealfastic, a pre-molded concrete joint sealer, is waterproof, has 100% expansion recovery up to one inch, and may be slipped into joints as thin as  $\frac{1}{8}$ " straight or curved. There is no drip or spillage, so it may be placed exactly at any elevation in the joint. In case of damage it may be replaced with hand tools. It will not ignite, is fuel resistant, and consists of one-inch bats of polyurethane foam, impregnated with a wide choice of types and colors of binders. The only equipment needed for installation is a simple hand-operated flattening tool.

National Expansion Joint Co., 1601 Embarcadero, Oakland, Calif.

Circle No. 3-15 on the convenient reply card facing page 34.

## Fiberglass Sign



These signs are manufactured of fiberglass reinforced polyester plastic panels. The sign messages are applied with a special epoxy resin paint that will not chip, peel, chalk or fade. The high strength fiberglass board and epoxy paints are inert to acid, industrial fumes and all climatic conditions.

Fiberglass Sign Co., P. O. Box 3042, Corpus Christi, Texas.

Circle No. 3-16 on the convenient reply card facing page 34.

## Backfill Blades

Three backfill blades for the Hop-to hydraulic excavator Series 500, 200 and 110 Snap-Mount, range in size from eight feet, weighing 490 pounds, down to four feet, weighing 130 pounds. These blades are designed to fasten onto the Hop-to excavating bucket, and the change from excavating to the backfilling operation can be accomplished in a fraction of the time required com-



pletely to change from one attachment to another. The blade can be carried piggy-back from job to job.

Badger Division, Warner & Swasey Co., Winona, Minnesota.

Circle No. 3-17 on the convenient reply card facing page 34.

## Repaver

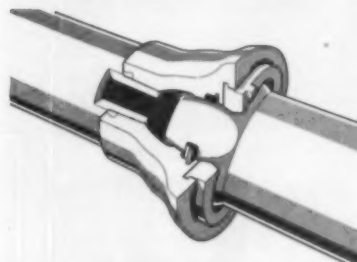
The Cutler Repaver is an asphalt highway maintenance machine combining in one machine the processes necessary to repair defects in an asphalt highway and then resurface the area with a new fifty-pound hot mix seal coat. In operation the unit works back and forth over an area heating, leveling and compacting. All of the original mix is used to build a good level base. After the road has been leveled, a windrow of new hot mix is spilled from a dump truck. The repaver finisher spreads this windrow to form a smooth sealing mat.

Cutler Engineering Co., Div. of Asphalt Equipment and Engineering Co., 5435 W. 63rd St., Chicago 38, Ill.

Circle No. 3-18 on the convenient reply card facing page 34.



## Flexible Joint



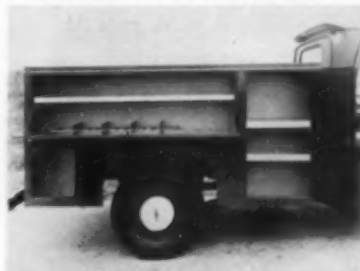
The joint provided with Usiflex pipe is a simple, rugged, bottle-tight flexible joint for cast iron pipe which is assembled without the use of bolts. Locked against pull-out, the joint is fine for underwater installations. No bolts, nuts or wrenches are required to make up the joint. The L-shaped gasket is self-sealing. Usiflex boltless flexible joint pipe is furnished in sizes 4-inch through 24-inch in nominal laying lengths of 18 feet.

U. S. Pipe and Foundry Co., 3300 First Ave., North, Birmingham 2, Alabama.

Circle No. 3-19 on the convenient reply card facing page 34.

## Service Body

A line of general service bodies, conversion kits, and side boxes for use on  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and 1-ton pickup truck chassis, the Highway general service body line is designed for applica-



tion in utility, construction, maintenance and contracting. Units are available for all popular makes of trucks, including those with dual rear tires. Inside floor space is 48 $\frac{1}{2}$  inches wide, with lengths of 75 to 104 inches, depending on chassis. Overall width is 77 $\frac{1}{2}$  inches; height is 42 inches overall, and 29 inches from floor to top. Side boxes are 14 $\frac{1}{2}$  inches deep. General service bodies have hinged tail gate with chain and hooks for positioning and locking.

Highway Trailer Industries, Inc., 250 Park Ave., New York 17, N. Y.

Circle No. 3-20 on the convenient reply card facing page 34.



## Cleaning Machine



An LP-powered Floormobile vacuum floor cleaner provides the features and mobility of gasoline models. The unit offers dust-free floor cleaning of large floor areas at speeds up to 20,000 sq. ft. an hour. It suction cleans dust, dirt, trash, etc., off the floor into an easily emptied dirt can.

Floormobile cleans a path 22" wide and yet its overall width is only 23". It is extremely maneuverable and cleans right up to walls, machines and cartons. It even gets into corners and cracks that can't be swept clean with a broom.

Handling Devices Co., Inc., 34 Concord Lane, Cambridge 38, Massachusetts.

Circle No. 3-21 on the convenient reply card facing page 34.

## Self-Loading Packer



A self-loading packer to collect refuse from existing Dempster-Dumpster Containers enables municipalities, military installations and private haulers to convert their existing container systems to on-the-spot collection service. Kits for the conversion of old containers to the system consist of lids and container handling side channels which can be welded into place.

The collector, designated the

Super Dempster-Dumpster, consists of a pair of truck-mounted clearance arms which empty the containers into the hopper opening of a 30 cu. yd. compaction body, where the material is compressed by the hydraulic packer plates. Depending upon the character and density of the material, the packer can haul up to the equivalent of 120 cu. yds. of loose refuse per trip.

Dempster Brothers, Inc., Knoxville, Tenn.

Circle No. 3-22 on the convenient reply card facing page 34.

## Sewage Pump

An electrical, fully-submersible, four-inch trash and sewage pump for handling sludge and slurries,



liquids and muddy water containing silt, weeds and other solids, the Flygt CS-100 has been successfully used by contractors and municipal and sewage authorities for pumping water and solids of toothpaste consistency. The CS-100, which consists of a pump unit and a 220/440 or 550-volt electric motor in an aluminum housing, is placed directly in the water to be pumped, the motor being sealed in a watertight compartment. A minimum of supervision is required and the pump is not damaged if it runs dry.

Flygt Corporation, Hoosick Falls, New York.

Circle No. 3-23 on the convenient reply card facing page 34.

## Backfiller

A machine, designed specifically for fast, low-cost backfilling, the Pow-R-Ditch Filler, deposits dirt back in the ditch in one pass. A rear-mounted 36 hp Wisconsin en-

gine powers the Ditch-Filler. Hydraulic power provides forward travel speed during backfilling. When in transport the unit uses



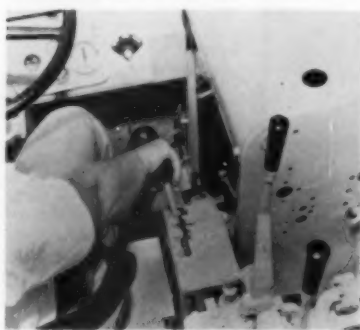
mechanical drive. Power steering is a standard feature. The operator's platform is located above the auger, allowing clear unobstructed visibility both ahead and behind the unit.

Vermeer Manufacturing Co., Pella, Iowa.

Circle No. 3-24 on the convenient reply card facing page 34.

## Tractor-Scraper

Two 420 maximum horsepower wheel tractor-scrapers, featuring an exclusive torque-divider power-shift transmission, the four-wheel 630 Series A and the two-wheel 631 Series A are powered by a valve-in-head, diesel engine that has a maximum rating of 420 horsepower and a flywheel rating of 335 horsepower. The 630A has a top speed of 41 miles per hour and the 631A, 31 miles per hour. Other machine features include 28-ply 29.5 x 35 tires, air-actuated cable controls, advanced design steering systems for both



units and a high degree of service accessibility.

Scrapers are of Lowbowl design and have a struck capacity of 21 cu. yds. and a heaped capacity of 28 cu. yds. Refinements to the basic Lowbowl concept permit corner voids to be filled without staying excessively long in the cut.

Caterpillar Tractor Co., Peoria, Ill.

Circle No. 3-25 on the convenient reply card facing page 34.

## Graderscraper



Designed for Caterpillar motor graders, the Graderscraper, GS-40, is a 4-cubic yard (heaped) scraper that mounts in place of the blade and circle on the grader. Optional sideboards are available to increase the capacity. Once loaded, the bowl can be lifted with the grader's circle lift arms and carried at speeds up to 20 mph to the dump area. Clearance in carry is 12½ inches.

The unit can be tilted to either side of the machine to cut ditch sides while the grader runs level. It can be shifted to cut on an angle of 30° and shifted nine inches out-

side the grader wheels. When tilted, it will cut a full 24 inches below ground level to form one side of a "V" ditch. It is designed to utilize existing connection points on Caterpillar graders and can be mounted or removed in about 35 minutes by one man. Basically, the unit was designed for use in light and medium leveling, general maintenance, irrigation, earthmoving and terracing.

Martin Company, 620 Andrews Ave., Kewanee, Ill.

Circle No. 3-26 on the convenient reply card facing page 34.

## Crushing Plant

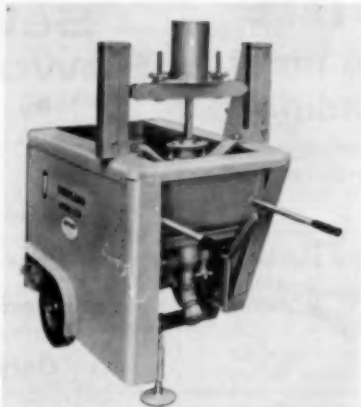
Two portable primary crushing plants, the 4336 and 3026 single impeller impact breakers, have capacities of 200-400 tons per hour and 150-250 tons per hour, depending on material characteristics and size of product. The Breakers are suited for use in material with a low silica content and produce a high volume of cubical aggregate with a low percentage of fines and a minimum of slabs, slivers and soft stone. Material is first reduced by striking whirling impellers and then hurled against a breaker plate and breaker bar for secondary reduction.

Iowa Manufacturing Co., Cedar Rapids, Iowa.

Circle No. 3-27 on the convenient reply card facing page 34.



## Pavement Jack



The Hydra-Jak for soil cement applications, slab raising and leveling (commonly referred to as mud-jacking), soil stabilization and underpinning is a combination pump, also used as a sand-cement grouter in backfilling sewers, tunnels and forms. Weighing 600 pounds, the model HJ-11 has a 6 hp Wisconsin air-cooled engine, a performance of 85-cubic-feet-per-hour, and will pump at pressures up to 150 psi. Airplaco, 1000 West 25th St., Kansas City 8, Missouri.

Circle No. 3-28 on the convenient reply card facing page 34.

## Soil Tester

A Dens-O-Meter to give accurate field tests for moisture density in a wide range of embankment and foundation soils, Model 15 is designed for holes up to 0.15 cu. ft. in volume and 8-in deep. It is convenient for one man operation in fine or coarse granular base soils and gravels. Parts are interchangeable with standard Model 30 in use throughout the world for fast, accurate field density and moisture



tests. Both Dens-O-Meters have been developed by soil engineers, Department of Highways, State of Washington.

Charles R. Watts Co., 4121 Sixth Ave., N.W., Seattle 7, Wash.

Circle No. 3-29 on the convenient reply card facing page 34.

## Two-Way Radio

A low-priced, lightweight, compact, two-way radio using vacuum tubes and simplified circuits, the General Electric Pacer has 15 tubes and 2 transistors. When the 15-watt unit is "on," battery drain is 4.2 amperes. The unit is 4¼ in. high, 7¼ in. wide and 12½ in. long, a total of 412 cu. in. Miniaturized with installation in compact cars in mind, it was designed to fit under the dash of new, small vehicles.

Section P, General Electric Communication Products Dept., P. O. Box 4197, Lynchburg, Va.

Circle No. 3-30 on the convenient reply card facing page 34.



## NEWS OF ENGINEERS

MILTON F. WAGNITZ, long time outstanding engineer in the public works field, retired March 1 as city engineer of Detroit, Mich., ending a 42-year career with the city. Two men will succeed him. CLYDE L. PALMER, assistant city engineer since 1954, becomes city engineer; ALFRED BERARDUCCI, assistant city engineer since 1957, succeeds as Second Deputy Commissioner of Public Works. GLENN C. RICHARDS is Commissioner.

JOHN W. CRAMER of the consulting firm of Fulton & Cramer, Lincoln, Nebr., is the nominee for president of the American Water Works Association. W. D. HURST, city engineer and chairman of the Commissioners of the Greater Winnipeg Water & Sanitary Districts, Winnipeg, Canada, has been nominated for vice-president. WILLIAM J. ORCHARD, long-time stalwart in the field, has been named for his fifth term as treasurer.

EDWARD J. A. GAIN has been made Technical Assistant to Executive Director PETER F. MATTEI of the St.

Louis, Mo., Metropolitan Sewer District. Formerly he was Chief of the Engineering-Design Department.

WILLIAM A. BUGGE, director of the Washington State Highway Department, has been elected 1961 chairman of the Highway Research Board. Mr. Bugge also received the Bartlett Award.

ARNOLD HAVERLEE, on leave of absence from the Cloroben Chemical Co., is in Mexico as leader of the Laguna Agua de Brava expedition with a group of American scientists. The purpose of the expedition is to study rivers and streams and collect insects, scorpions, spiders and aquatic vegetation for the American Museum of Natural History, New York City. The expedition carries explorers Club Flag No. 73, which Mr. Haverlee carried in the Arctic 30 years ago, but this time the work is in largely unmapped tropical jungle and mountain country.

WILLIAM G. RIDDLE has formed the consulting engineering firm of William G. Riddle & Associates, with offices at Country Club Plaza, 47th & Belleview, Kansas City, Mo. Associates will include CHARLES P. BROOKS and BEN F. RIGGIN, engineers, and DONALD PHILO, engineer and architect.

JAMES J. SULLIVAN has been appointed waste superintendent for Metropolitan Dade Co., Florida. He has been Superintendent of Streets and City Engineer of Springfield, Mass., since 1953 and before that was engineer for the Springfield Board of Public Works. In Dade County he will have charge of garbage and trash collection in the unincorporated areas.

ERIC F. JOHNSON, assistant secretary and director of publications of the AWWA, has been made director of the AWWA Advancement Program. LAWRENCE FARBER becomes assistant director of publications and ARNE GUBRUD becomes assistant director of advancement. ROBERT A. NYE is now responsible for AWWA Journal advertising and circulation and is manager of membership services.

JOSEPH M. DE SALVO is now a general partner in the consulting engineering firm of Joseph S. Ward & Associates, Caldwell, N. J., specialists in soils and foundations.

GERALD T. MCCARTHY, senior partner of Tippetts-Abbett-McCarthy-Stratton, consulting engineers of New York, has been elected president of the American Institute of Consulting Engineers.



## STAINLESS STEEL Well Casing to meet every Soil Condition

from 6" to 36" diameter and 4 different perforations to meet your special requirements. For a permanent, trouble free well put down Thompson Stainless Steel Casing.

## Parshall Measuring Flume

Accurate to .02 regardless of stream velocity, self cleaning, easily read, approved by State Engineers. 6" to 12" throat widths galvanized or black. Ideal for water and sewage control.



## Automatic Control Gates



Control water levels, upstream or downstream, assures equitable distribution 24 hours a day...entirely self operating...no gate keeper necessary. Prevents costly washouts and flood damage. Proven in USA, Europe and Africa. Write for full information...there may be an automatic gate near, for your inspection.

Ask for catalog on

- |   |  |
|---|--|
| <input type="checkbox"/> Well Casing        | <input type="checkbox"/> Parshall Measuring Flumes     |
| <input type="checkbox"/> Custom Fabrication | <input type="checkbox"/> Automatic Water Control Gates |

**THOMPSON PIPE & STEEL CO.**  
3025 Larimer Street Denver 1, Colorado

TP 9-6

## Sewerage and Sewage Treatment

By W. A. HARDENBERGH

Editor, Public Works Magazine; formerly Chief, Sanitary Corps, U. S. Army

A Useful Book  
For Your  
Engineering Library

Only \$7.25



A N authoritative yet simple treatment of the subject by one of the nation's foremost authorities. Mr. Hardenbergh's editorial and field work have brought him in close contact with the problems that trouble the average engineer. And in this book he explains those methods most suitable for handling the work. Special attention is paid to sewerage systems, both storm and sanitary.

Design examples of all kinds are worked out in detail to illustrate practical, up-to-date methods.

467 pages, liberally illustrated.

Priced at \$7.25 a copy, postpaid, this book is being sold under our regular money-back-if-not-satisfied guarantee. Mail your remittance with your order and if not more than satisfied with this edition, you may return it within 10 days for full refund.

**PUBLIC WORKS Magazine**  
200 South Broad St., Ridgewood, N. J.



## PCA Fellowships For Graduate Students

The Portland Cement Association has made 20 fellowships to the Graduate School of Purdue University available for the summer session starting June 19 and ending August 11. In addition to payment of tuition, fees and transportation expenses, fellowships also include a cash stipend of \$700. The study program, which will include courses in concrete and aggregates, highway planning, and economics and pavement design, will be supplemented by a symposium conducted by outstanding authorities in highway engineering. Application forms and other information concerning the fellowships can be obtained from Professor K. B. Woods, School of Engineering, Purdue University, Lafayette, Indiana.

## Louisiana Short Course

The 24th Annual Short Course for superintendents and operators of water and/or sewerage systems will be held at Louisiana State University, Baton Rouge, March 15 to 17. More details are available from Dean F. H. Fenn, Director, Engineering Experiment Station, LSU, Baton Rouge 3, La.

## Hydraulic Calculator For Flow in Pipes

A calculator specifically designed for the solution of pipe flow and water distribution problems has been developed as a 6-in. diameter circular slide rule. It is based on the Hazen and Williams formula and can be used for determining head loss, flow, velocity, size of pipe and the differential of the head loss,  $1.85 h/Q$ , a factor used in the solution of Hardy Cross problems. Total friction loss for pipe lines of any length, from 100 to 20,000 ft. may be obtained direct without the necessity of finding the slope per 1000 ft. The position of the decimal point on the head loss and differential of head loss scales has been established.

Several values of C are shown for 4 to 42-in. pipe. Single C values are shown for pipes up to 72 inches in diameter with a conversion chart for any other C value.

The calculator consists of three parts: A movable indicator arm, an interscale disc and an outerscale disc. Total head losses (or slope per 1000 ft.) from 0.06 ft. to 250 ft. are shown. Discharge is given in both MGD and GPM. The inventor is Robert E. Martin, Consulting Engineer, 5402 Preston Highway, Louisville, Ky.

# CLASSIFIED ADVERTISING AND JOB OPPORTUNITIES

## MANAGEMENT OPENINGS AUTOMOTIVE SPECIALISTS

The City of Philadelphia's modern progressive administration has two excellent opportunities for individuals in the automotive field who are capable of top level responsibility and leadership.

### DIRECTOR

Chief responsibility will be operational direction of a large dynamic expanding maintenance organization. Will direct the development and implementation of policies, programs and procedures related to purchase, sale and trade-in of automotive equipment, design, layout and expansion of automotive shops and other facilities.

### AUTOMOTIVE ENGINEER

Work would involve preparation of specifications for new equipment (vehicles, tools and shop), developing maintenance programs and procedures, and shop and equipment layouts. If interested, write full details of background and salary needs to:

Commissioner William T. Gennetti  
Department of Public Property  
1302 City Hall Annex  
Philadelphia 7, Penn.

## Director of Public Works

The City of Ojai, California is seeking a Director of Public Works. Population 5,000. Salary range \$626 to \$745. Desire California Civil Engineering registration and some municipal experience. A unique fine living community.

Send detailed resume to:

City Manager  
City Hall  
Ojai, California

## Assistant City Engineer

Salary, \$534.26 to \$650, depending upon experience. Degree in Civil Engineering, plus experience in road and street design. Will involve supervision of small staff of aides and assistants. Position to be filled April 1, 1961.

Send resume to:

Personnel Officer  
City Hall  
Richland, Washington

## IF YOU WANT TO:

- Sell Used Equipment
- Hire Personnel
- Obtain Employment
- Make Announcements

Use Our Classified Section  
For Quick Results

Write to:

Classified Ad Dept.  
Care of this Magazine

## WATER WORKS REPRESENTATIVE

Man with following at Water Works Purchasing level to contact local officers. Attractive commission basis.

Write to:  
Box 3-1

Public Works Magazine  
200 South Broad Street  
Ridgewood, New Jersey

## MUNICIPAL SALESMAN

Man with contacts among City, Town Officials, etc. to sell lucrative commission line of equipment. Age not important.

Write to:  
Box 3-2

Public Works Magazine  
200 South Broad Street  
Ridgewood, New Jersey

## FOR SALE

24 inch sewerage test plug, W2-4 inch taps, brand new. For information write to:

Azalea Park Utilities, Inc.  
5813 Dahlia Drive  
Orlando, Florida  
Phone: CR 7-1321

## Incinerator Units For Sale

Available for dismantling four Pittsburgh Des Moines incinerator units installed in 1941 and used 5 years. Excellent condition.

For information contact:

Park District of Highland Park  
1801 Sunset Road  
Highland Park, Illinois

## SPECIAL REPRINT OFFER!

Following three reprints are being offered at special reduced prices.

• The Use of Photometric Instruments for Colorimetric Analysis of Water and Wastes.

• Stream Life and the Pollution Environment.

• Actinomyces May Cause Tastes and Odors in Water Supplies

one copy .....	\$25
five copies .....	\$1.00
10 copies .....	\$1.75
25 copies .....	\$2.50
100 copies .....	\$5.00

All reprints sold on a money back guarantee.

Order your copies today from:

Public Works Magazine  
200 S. Broad St.  
Ridgewood, New Jersey

# INDEX OF ADVERTISEMENTS

Acker Drill Co., Inc. ....	138	Fairbanks Morse & Company ....	171	Pacific Flush Tank Co. ....	165
Adams Co., Inc., R. P. ....	44	Fisher Research Lab., Inc. ....	192	Palmer Filter Equipment Co. ....	46
Air Placement Equipment Co. ....	24	Fitchburg Engineering Corp. ....	139	Permutit Division ....	181
Alabama Pipe Co. ....	150	Flexible, Inc. ....	14 & 15	Pfaudler Permutit Int. ....	66
Allied Chemical Corporation ....	139	Flex-O-Lite Manufacturing Corp. ....	83	Pfaff & Kendall ....	161
28, 29 & 177		Flintkote Co. (Orangeburg Div.) ....	185	Philadelphia Gear Corp. ....	161
Amchem Products, Inc. ....	148	Flygt Corporation ....	53	Pittsburgh Plate Glass Company ....	185
Amercoat Corporation ....	168	Ford Motor Company ....	80 & 81	Pomona Terra-Cotta Co. ....	26 & 27
American Bitumuls & Asphalt Co. ....	37	Ford Motor Company ....	60, 67 to 70	Preload Company, Inc. ....	190
American Concrete Corporation ....	128	Tractor & Implement Division ....		Price Brothers Company ....	61
American-Marietta Company ....	39	Formax Inc. ....	188	Public Works ....	190 & 206
Concrete Products Division ....		Foster Company, L. B. ....	18		
American-Marietta Company ....	19	Foxboro Company ....	30 & 31		
Adhesives, Resin & Chemical Div. ....					
American Playground Device Co. ....	50	Galion Iron Works & Mfg. Co. ....	17	Reed Manufacturing Company ....	62
American Steel & Wire ....	72 & 73	Gar Wood Industries, Inc. ....	130	Roberts Filter Mfg. Co. ....	174
Div. of United States Steel ....		Georgia-Pacific ....	79	Rockwell Manufacturing Company ....	75
Armco Drainage & Metal Products ....	41	Gorman-Rupp Company ....	149	Roof Manufacturing Company ....	192
Asplundh Chipper Co. ....	84				
Auburn Machine Works, Inc. ....	187	Hamilton Kent Mfg. Co. ....	43	Simplex ....	82
Aurora Pump Division ....	154	Hersey-Sparling Motor Co. ....	151	A Division of Pfaudler Permutit Inc. ....	
The New York Air Brake Co. ....		Hough Company, Frank G. ....	133	Smith & Loveless ....	167
Ayer-McCord Clay Co., Inc. ....	26 & 27			Smith Mfg. Company, A. P. ....	163
		International Harvester Co. ....	25, 64, 65 & 74	Smith & Company Inc., Gordon ....	52
B-I-F Industries ....	78	Iowa Valve Company ....	153	Standard Steel Works, Inc. ....	132
Badger Meter Mfg. Company ....	47	Subsidiary of James B. Clow & Sons, Inc. ....		Steel Plate Fabricators Assoc. ....	160
Baughman Manufacturing Company ....	12			Staier & Sons, Inc. ....	140
Bathlehem Steel Company ....	144 & 145	Jaeger Machine Co. ....	50	Synchro-Start Products Inc. ....	54
Bowerston Steel Co. ....	26 & 27	Jeffrey Mfg. Co. ....	169		
Butler Manufacturing Company ....	49	Johns-Manville ....	157	Tarrant Manufacturing Co. ....	142 & 174
Byers Company, A. M. ....	71			Taylor & Co., W. A. ....	210
		Katolight Corporation ....	140	Tennessee Coal & Iron Division ....	72 & 73
Cannellon Sewer Pipe Co. ....	26 & 27	Kohler Company ....	40	Tennessee Corporation ....	86
Case Company, J. I. ....	53 & 147	Komline-Sanderson Engr., Corp. ....	13	Texas Vitrified Pipe Co. ....	26 & 27
Cast Iron Pipe Research Assoc. ....	10 & 11			Tox-Vit Manufacturing Co. ....	47
Caterpillar Tractor Company ....	85	Lely Ltd. ....	193	Thiokol Chemical Corp. ....	143
Engine Division ....		LeTourneau-Westinghouse Co. ....	141	Thompson Pipe & Steel Co. ....	207
Caterpillar Tractor Company ....	4, 20 & 21	Limitorque Corporation ....	161	Trickling Filter Floor Institute ....	26 & 27
Chevrolet ....	76 & 77	Link-Belt Company ....	179	Troy Blanket Mills ....	137
Div. of General Motors ....		Lock Joint Pipe Co. ....	155		
Chicago Bridge & Iron Company ....	158 & 159	M-B Corporation ....	138	Union Metal Manufacturing Co. ....	45
Chicago Pump Company ....	3	M & H Valve & Fittings Co. ....	182	Unit Crane & Shovel Corp. ....	175
Clark Equipment Company ....	135	McCabe-Powers Body Company ....	Second Cover	United States Concrete Pipe Co. ....	35
Construction Machinery Division ....		McConaughy Mixers, Inc. ....	136	United States Steel Corp. ....	72 & 73
Classified Ads ....	207	McGowan Pumps ....	192	United States Steel Export Company ....	72 & 73
Cleveland Trencher Company ....	23	Division of Leyman Mfg. Corp. ....			
Columbia-Geneva Steel Division ....	72 & 73	Minneapolis-Moline Company ....	9	Valley Manufacturing Co. ....	54
Columbia-Southern Chemicals Corp. ....	185	Modern Products, Inc. ....	42	Vermeer Manufacturing Company ....	36
Computer Measurements Company ....	22	Morse Baugier Inc. ....	190	Visi-Meter, Inc. ....	193
Utilities Instrument Division ....		Mueller Co. ....	63 & 90		
Continental Machinery Corp. ....	48	Natco Corp. ....	26 & 27	Wald Industries, Inc. ....	51
Darley & Co., W. S. ....	50	National Clay Pipe Mfgs., Inc. ....	8	Wallace & Tiernan Co., Inc. ....	Back Cover
Darling Valve & Mfg. Company ....	156	Neenah Foundry Company ....	140	Wausau Iron Works ....	46
Deere, John ....	32 & 33			Wesley Chemical & Supply Co. ....	186
Dempster Brothers ....	173	Oliver Corporation ....	Third Cover	Westinghouse Electric Corp. ....	56 to 59
Detroit Stoker Company ....	12	Orangeburg Mfg. Co. ....	180	Weston Co., L. A. ....	142
Div. of United Industrial Corp. ....		(Div. of The Flintkote Co.) ....		Whiting Company, E. B. & A. C. ....	38
Dickey Clay Mfg. Co., W. S. ....	26 & 27			Williamette Iron & Steel Company ....	16
Dixon Crucible Co., Joseph ....	170			Wilco Machine Works, Inc. ....	144
Dresser Mfg. Division ....	191			Wilkinson Products Company ....	48
Econalite Corporation ....	6				
Elmo Corporation ....	183				
Essick Mfg. Company ....	187				
Essick ....	88 & 89				
Div. of General Motors Corp. ....					
Evans Pipe Company ....	131				

CONSULTING ENGINEERS APPEAR ON PAGES 194 to 199

## PUBLIC WORKS JOURNAL CORPORATION

200 South Broad Street

Ridgewood, New Jersey

### OFFICERS

W. A. Hardenbergh, President

Lewis C. Morris, Vice President and Treasurer

Edward B. Rodie, Secretary

### BUSINESS DEPARTMENT

Lewis C. Morris, General Manager

Arthur K. Akers, Director, Advertising & Research

I. James Barger, Business Manager

### ADVERTISING OFFICES

CHICAGO 1, ILLINOIS  
333 N. Michigan Avenue  
Robert J. Shea  
Mid-West Sales Mgr.

CLEVELAND 41, OHIO  
10531 Snowville Road  
Burton M. Yost,  
District Manager

KANSAS CITY, MO.  
4916 West 64th St.  
Mission, Kansas  
C. H. Stockwell

LOS ANGELES 36, CALIF.  
5478 Wilshire Blvd.  
% Smith and Hollyday  
Hugh Hollyday  
David W. Zander

PHILADELPHIA 10, PENN.  
1434-36 Land Title Bldg.  
Rod Ellis

RIDGEWOOD, NEW JERSEY  
200 South Broad Street  
W. S. Morris

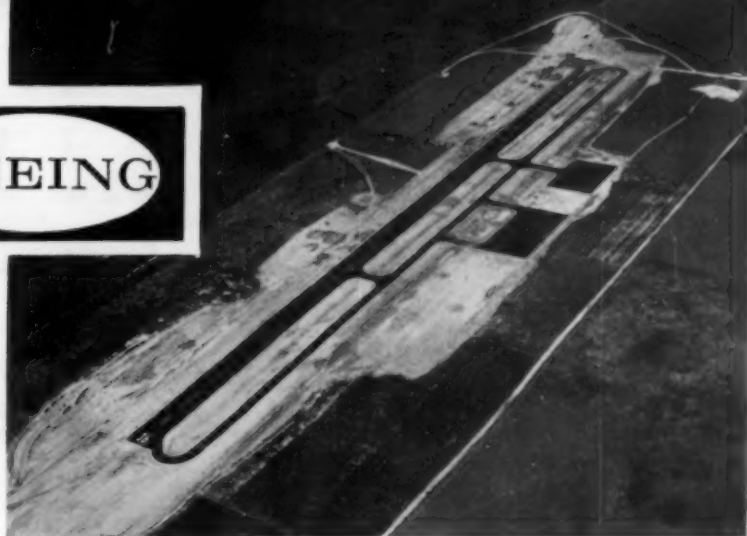
SAN FRANCISCO 4, CALIF.  
22 Battery Street  
% Smith and Hollyday  
Bill Smith

LONDON, W.1., ENGLAND  
Regency House  
1 Warwick Street  
Norman F. Keenan

**WORTH**

**SEEING**

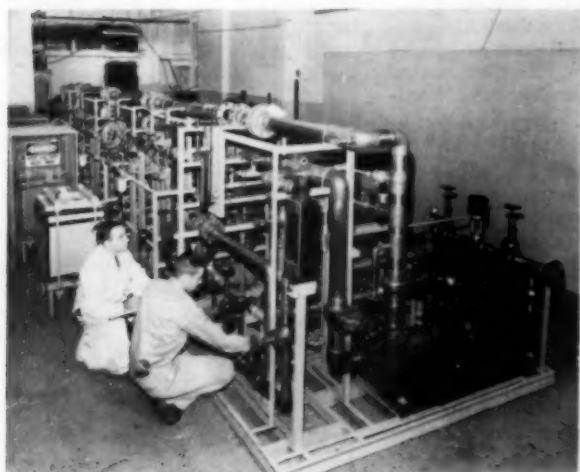
5000-ft. runway of the new Municipal Airport at Ocala, Florida, which is said to have set a record of low unit construction cost with highest quality workmanship. Clearing, grading, drainage, stabilization, base, paving, lighting and wind cone came to less than \$3.40 per square yard. National Bituminous Concrete Association photo.



Long reach of a Warner & Swasey Gradall with special bucket and extension permitted operator to dig a trench for State highway illumination cables without disturbing the existing guard rail.



A versatile machine for the Denver, Colorado, Water Board is its Model H-90 Hough Payloader tractor shovel equipped with a side boom. Unit is shown laying a 12-inch cast iron water main.



Twelve desalting plants using the electric membrane principle to treat water from highly mineralized well supplies at Air Force missile bases are being shipped by Ionics, Inc. Total capacity will be one-half mgd.



Cleveland's Public Square, site of the world's first street lighting installation, now has more than 100 General Electric Power-Groove fluorescent luminaires that produce a roadway illumination of 4.5 footcandles.



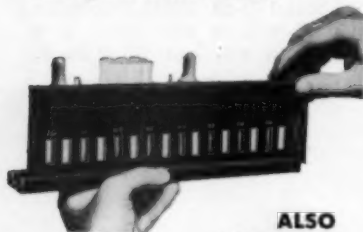
# I FELT THIS BIG!



**(Taylor Comparators brought me back to normal)**

Have you ever tried to explain how things got out of whack because the comparator you selected wasn't right for the job? Making tests as often as we do, I should have known a comparator with fragile, individual color standards wouldn't last long. Somebody was bound to drop two or three of them. But, we solved the problem by buying Taylor Comparators.

Taylor Comparators—with accurate, guaranteed non-fading color standards in a single, easy-to-use slide—give you fast, accurate, on-the-spot tests for pH and chlorine. You get dependable data for controlling coagulation, filtration, chlorination and algae in water treatment.



**ALSO AVAILABLE**

Taylor Water Analyzer for colorimetric water analysis, Taylor Comparator Model L-4 for pH, chlorine tests.

**ALL TAYLOR COMPARATORS HAVE GUARANTEED NON-FADING COLOR STANDARDS**



SEE YOUR DEALER for Taylor Sets or immediate replacement of supplies.

**FREE HANDBOOK**, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full Taylor line.

**W. A. TAYLOR AND CO.**  
7304 YORK RD. • BALTIMORE-4, MD.



by Arthur K. Akers

★ Cushman Motors, Lincoln, Neb., will supply U. S. Post Office Dept. with 1,200 new Cushman Mailsters, a 3-wheel motor vehicle for suburban and rural mail delivery.

★ Fred D. Crowther becomes president of the Henry Pratt Co., Chicago, makers of butterfly and ball valves. He was recently with the Chapman Valve Mfg. Co.

★ James M. Hughes appointed to direct sales of pipe jointing and repair products, Dresser Mfg. Div., Bradford, Pa.



Mr. Hughes



Mr. Wendell

★ Erwin A. Wendell succeeds Bertram V. Jones as manager of advertising and W. H. Depperman as director of public relations, Link-Belt Co., Chicago.

★ Alabama Pipe Co., Div. of Woodward Iron Co., Anniston, Ala., announces Lee J. Molter as special sales representative in five central states, with Louisville, Ky., headquarters.

★ With purchase of Load Lugger and Huge Haul system by the Heil Co., Milwaukee, go three key Ingersoll-Rand executives to Heil, including A. M. Klingler as sales manager.

★ Tom W. McCreery, until his 1959 retirement, long Southern sales manager for the U. S. Pipe & Foundry Co. at Birmingham, died January 3, just two weeks following the death of his wife.

★ Robert E. Scott appointed truck fleet sales manager, International Harvester Co.

★ Edward G. Cole, Jr., president of R. D. Cole Mfg. Co., Newnan, Ga., elected president of the Steel Plate Fabricators Association.

★ James B. Clow & Sons, Inc., opens a new sales office in Indianapolis under Dale R. Hanson's management.

★ Carling Sales Co., Bergenfield, N.J., now represents Gordon Smith Co. in East Coast sales of portable compressors, Maryland to Maine inclusive.

★ Ray C. Freseman appointed assistant to Managing Director Howard Peckworth of the American Concrete Pipe Association, Chicago.

★ Roland J. ("Rollie") Leveque, formerly with B-I-F Industries, Providence, named executive secretary, Allied Scientific Corp., with headquarters in Richmond, Va.

★ Trojan Tractor Shovel division of Yale & Towne Mfg. Co. names Edward D. Gorton and Samuel S. Rockwood Eastern and Western sales manager, respectively.

★ C. A. Clarke elevated to post of director of sales, The Miro-Flex Co., Wichita, Kans. John D. (Jack) Gebert succeeds him as sales manager for this important manufacturer of street name and traffic control signs.

★ General American Transportation Corp. of Chicago has acquired Infilco Inc. of Tucson, Ariz. Infilco will continue to operate under its present management.

★ M-B Corp., New Holstein, Wis., acquires repair stock and manufacturing rights, the Detroit Harvester Sweeper Co., Zanesville, Ohio. Future operations will be centered in New Holstein.

★ Little monster: "Mother, the teacher asked me if I had any brothers and sisters, and I said no." Mother, "And what did teacher say?" Monster: "She said 'Thank God!'"



**Five times the work  
at half the cost with an  
OLIVER OC-96!  
TRANS O MATIC**



**NEW CATALOG—**  
"must" reading for cost-conscious cities and towns. Gives complete details and specifications. Ask for your copy.

Ask Joel Jenkins, superintendent of Lower Penns-Neck, New Jersey, township road department, why his town bought an Oliver OC-96 for sanitary landfill operations. "To save money!" he'll tell you. "We get five times the work out of our OC-96 as we did out of the dozer and loader previously used. The OC-96 costs us 100% less to operate than the two old machines!"

Power, speed and ease of operation are OC-96 features that make the difference, according to Mr. Jenkins. "We cover 70 tons of refuse a week with 8" topsoil, as required by state law, and have time left to beef-up muddy truck lanes with 30 cu. yd. of cinders per week and rough-grade an acre of ground every day," says Mr. Jenkins. "The OC-96 is so effortless to operate and such a good all-around machine, we're going to use it on other jobs all over the township."

See and try the great new Oliver Trans-O-Matic OC-96 yourself—the only crawler in its class with these advantages: heavy-duty torque converter, and three types of turns. The OC-96 gives you the job-versatility with greater speed and lower cost every city and town needs. Ask your Oliver distributor for a demonstration.

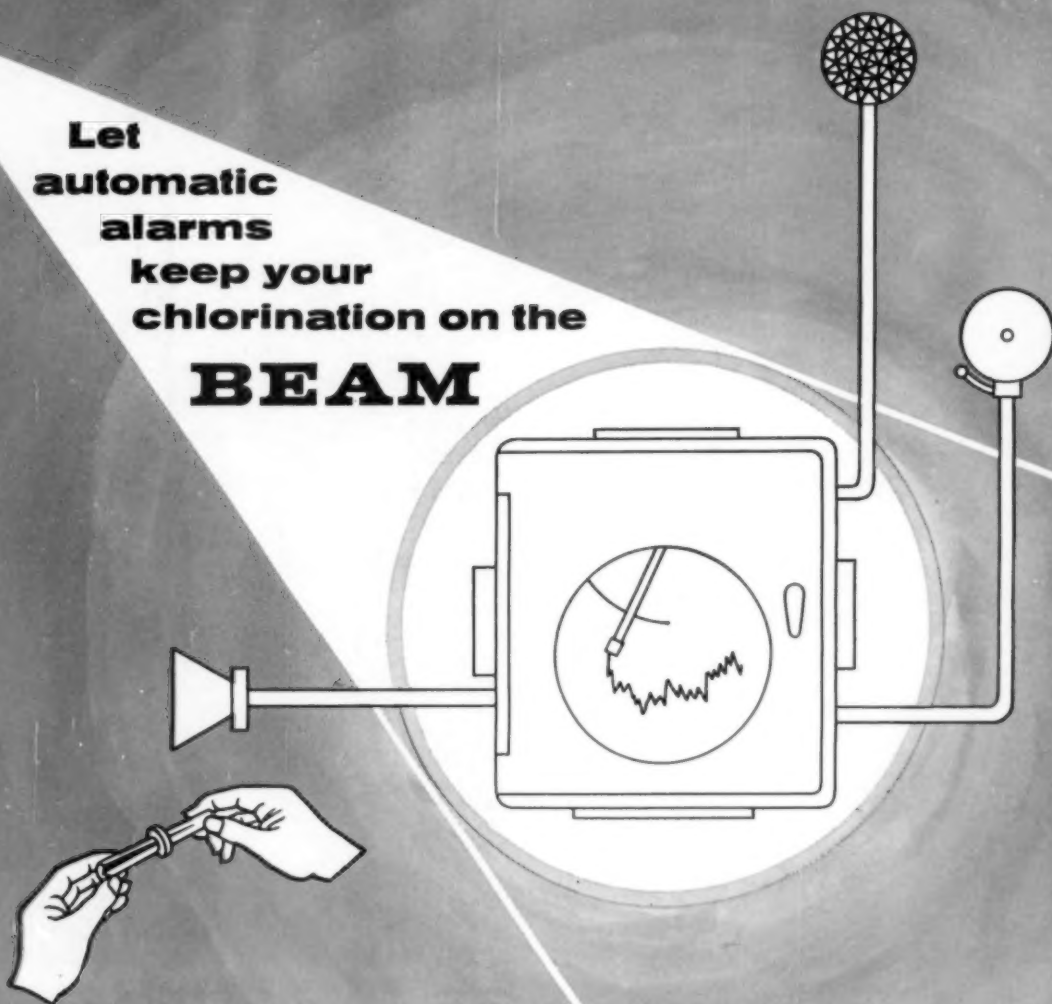
OLIVER CORPORATION, CHICAGO 1, ILLINOIS

SEE YOUR  
**OLIVER**  
DEALER



Turn to your dependable Oliver dealer when you need hurry-up service and genuine Oliver spare parts

Let  
automatic  
alarms  
keep your  
chlorination on the  
**BEAM**



Convert your chlorine system to a system that watches itself, monitors its own results. Conversion is easy with Wallace & Tiernan Automatic Alarms. These dependable warning devices aid in overall operating efficiency...give you the final assurance that your system is operating properly, that your water is safe. And these alarms are flexible enough to tie in with any physical layout, any type of signal.

W&T Alarms warn of any deviation from desired performance. You get audible or visible warnings, at or remote from the chlorinator. Alarms warn you of dangerous pressure increases, lowered or exhausted chlorine supply, malfunctions in auxiliary equipment, and other hazards. And, to keep your system "on beam" at all times, alarms show residuals outside pre-set limits. With automatic alarms by Wallace & Tiernan you avoid dangerous underchlorination and wasteful overchlorination. You save man-hours for more efficient use of personnel.

*For more information, write Dept. 143.78*



**WALLACE & TIERNAN INCORPORATED**

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY





